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ABSTRACT

Contained in this teacher's manual are over 40 energy education activities for elementary school students. Lessons are designed for science, social studies, mathematics, and language arts classes. This approach is intended to allow teachers to provide students with energy-related learning opportunities throughout the school program as parts of courses that are already being taught. Activities are organized under six major topic headings: (1) Energy - The Concept, (2) Energy Sources, (3) Energy Uses, (4) Energy Conservation, (5) Energy and Economics, and (6) Energy and the Environment. Learning strategies employed range from class discussions and values clarification experiences to model building, performing experiments, and using resource materials. Lesson plans include objectives, skills, background information for the teacher, required preparation, references, student handouts, and step-by-step procedures for carrying out the activities. (WB)

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## ENERGYWATCH VOLUME I CURRICULUM GUIDE

Our nation faces critical energy choices in the years ahead. The future of our society could very well depend on how future generations respond to this challenge. In recognition of this situation, the State Board of Education has developed Energywatch Volume I Curriculum Guide for grades K-6.

This curriculum guide offers an interesting and practical approach to the subject, which will make the study of energy conservation and the protection of our environment most enjoyable and involving for all youngsters.

By placing emphasis in this area, our schools can help students to develop responsible attitudes toward our current energy situation, as well as alternative resources. The success of our efforts will be reflected in the quality of life for future generations.

This guide encourages both discussion and "hands-on" projects in order to create an understanding of energy-related issues. For these reasons. it can be an exiting and challenging resource in every classroom.

All of us involved in educating young people have a responsibility in making future generations energy-wise. This guide should be considered one effective tool in this long-term process.

Mark R. Shedd
Commissioner of Education

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# ENERGYWATCH

## DESIGNING ENERGY EDUCATION INTO THE CURRICULUM

VOLUME 1

grades K - 6

produced for

CONNECTICUT STATE DEPARTMENT OF EDUCATION

by the

School Services Unit

of

Area Cooperative Educational Services

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November 1980

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# PREFACE

Throughout history, American education has been responsive to the demands placed upon it by its constituents to resolve human problems. Curriculum—the what of learning—is influenced by both societal advancements and concerns.

Energy is a major concern that touches the lives of all people. Thus, schools are involved in efforts that affect our destiny. Today's students must be enlightened concerning the importance of adopting an energy conservation ethic, a style of living which strives to use energy more efficiently for the good of present and future generations. If schools are to be a part of the solution to the energy problem, they must nurture creative social and scientific thought, and provide training and experience in problem-solving. Teachers are charged with the critical responsibility of providing students the opportunity to gain knowledge and develop attitudes that will affect their entire lives.

It is important for all of us to develop an increased awareness of energy-related issues. To check your own knowledge and understanding, take the "EQ" Test on the following page. The answers can be found on page xii.

# Test Your E.Q.*

* *Energy Quotient.*

1\.

____ How much of the energy used in gas stoves supplies the pilot lights?

a. 10%

b. 25%

c. 50%

____ 2. An incandescent lamp and a fluorescent lamp have the same light output: Which uses energy more efficiently?

a. fluorescent

b. incandescent

c. both about the same efficiency

____ 3. How many soft drink cans can be manufactured from recycled aluminum with the energy needed to make a single can from aluminum ore?

a. three

b. five

c. twenty

____ 4. How much heating oil would be saved on a typical winter day if the attics of single family homes that needed insulation were properly insulated?

(a) 2%

(b) 8%

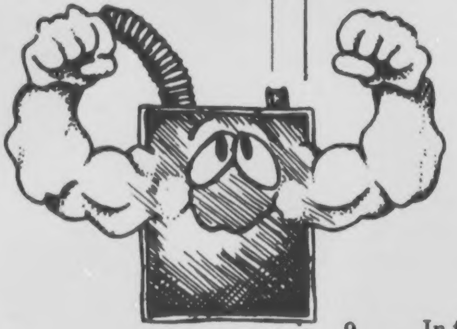
(c) 50%

____ 5. How much of the energy stored in crude petroleum is lost between the oil well and a moving car?

a. 20%

b. 60%

c. 90%



____ 6. The heat energy of a gallon of gasoline is equivalent to

a. 5 man-days of labor

b. 15 man-days of labor

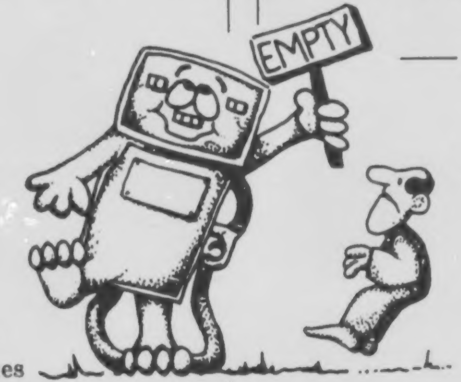
c. 25 man-days of labor

____ 7. How much faster than their rate of production are we consuming our fossil fuels?

a. 10 times

b. 1,000 times

c. 1,000,000 times



____ 8. What fraction of the world's energy consumption occurs in the U. S.?

a. over 10%

b. over 20%

c. over 30%

9. ____ In the year 2000, American total energy demand will be:

a. the same as today

b. twice as much as today

c. three times as much as today

____ 10. Which of the following fuel resources is in greatest danger of exhaustion?

a. coal

b. petroleum

c. natural gas

# INTRODUCTION

"My interest is in the future, because I am going to spend the rest of my life there."

–C. F. Kettering

Due to national and international developments during the 1960's such as deterioration of air and water quality, soaring gasoline prices, contaminated drinking water, and depletion of natural resources, educators came to realize the need for introducing students to relevant concepts directly related to environmental issues. Striving to serve the needs of society, a new dimension called "environmental education" evolved during the later part of the decade. Most educators agreed that environmental education should be dedicated to producing environmentally literate citizens. In other words, such a process should produce citizens equipped with factual and unbiased information concerning the basic ecological systems, skilled in problem-solving and decision making and motivated to take an active role in working toward the maintenance of an ecologically-sound environment.

The ultimate objective of involvement in a learning program related to energy is to enable people to think reasonably and thoughtfully about energy issues. This will come about through specific and continued learning experiences. Any single experience is not enough. In time, experiences will accumulate to the extent that students can visualize patterns and causes and effects which make sense to them and which relate to other aspects of life.

In order to reach this goal, it is important that students have energy learning experiences on a continuing basis throughout their lives. There are basically two approaches to implementing energy education to reach this goal:

1. Energy education uses the skills and information of various disciplines.
2. Each discipline can use energy activities to teach the knowledge and skills of that discipline.

The problem of the first approach is that if we continue to "take time out" from the everyday instructional program to deal with energy issues, they will remain adjunct concerns. In addition, there is always the problem of one more unit in an already crowded program. On the other hand, if we prepare a program of instruction which is customized with or has energy objectives built in, our attention to such concerns will be as regular and automatic as the social occurrence of the issues themselves. It is this second alternative that has been developed in this notebook of activities.

Infusion is not a new concept. It is in fact an integral part of the entire education process. Every teacher strives to integrate and piece together for their students the many topics, subjects and categories that divide the school day. Writing skills are not isolated exercises to be performed during an English lesson but are important tools of communication in science, social studies and the language arts.

Our ENERGYWATCH is a two-fold response to this aspect of the teaching process. In response to the crowded curriculum, the infusion approach frees a teacher to energize their classroom to any extent. By selecting one or more energy infusion activities, a teacher can highlight energy in key spots throughout the school year. And perhaps more importantly, by integrating energy education into a multitude of disciplines and topic areas, the students' thinking comes to reflect an energy ethic which spans the individual curriculum topics. Rather than viewing energy education as a day to turn off lights or as a bulletin board of posters, students begin to apply their energy awareness and knowledge in all their classroom activities and investigations.

The primary objective of ENERGYWATCH is to closely link participating school district curriculums to opportunities in energy education. These opportunities were identified by the staff using school district curriculum guides and energy topics established by the Connecticut Department of Education. These were integrated into a giant matrix. The horizontal axis recorded science, social studies, mathematics and language arts curriculum topics gleaned from a careful analysis of school programs. The vertical axis, a framework for energy education, was conveniently divided into six major topics: Energy-Concept, Energy-Sources, Energy-Uses, Energy-Conservation, Energy and Economics, and Energy and Environment. Using the matrix as a guideline, the writers worked diligently to create and rework curriculum activities to highlight the energy issues which emerged from these curriculum areas.

Although this approach to the development of curriculum materials seems long and complex, it is based on the belief that by incorporating energy education concepts into an ongoing curriculum several benefits can be derived. First, continuation of energy education instruction can be assured, without the necessity of massive external funding sources. Second, by incorporating these concepts at appropriate places in many areas of study, energy education can remain dispersed throughout the curriculum and not become a specific entity or source that should be taught at a certain grade level. This allows students to be introduced to energy materials at all grade levels and in almost all subject areas in a subtle, yet reinforcing manner, assuring the transdisciplinary nature of energy education. Third, by allowing teachers to introduce energy topics within the framework of the courses they are already teaching, their confidence in themselves and the materials can be maintained, and the need for extensive teacher in-service training can be kept to a minimum.

We understand learning to be a change in either behavior or in pattern of thinking which follows upon an accumulation of experiences. Infusing energy education into a variety of subjects and grades can provide the diversity of experiences for energy learning while preserving the integral fabric of a curriculum designed to develop specific skills and content.

# USER'S GUIDE

## FINDING AN ACTIVITY

There are three procedures which may be used to utilize this notebook.

### Option I

Turn to the list of curriculum topics in the Curriculum Index on page x. These curriculum topics are listed by discipline Choose an appropriate curriculum topic. After each curriculum topic are page numbers to identify activities which teach that topic.

### Option II

The activities are divided into six sections based on six energy topics: (1) Energy - Concept, (2) Energy-Sources, (3) Energy - Uses, (4) Energy - Conservation, (5) Energy and Economics and (6) Energy and the Environment. Immediately following each energy division in the notebook, there is a table of contents which lists the activities in that section by descriptive title and page number.

### Option III

Turn to the matrix on page xi. The six energy topics are listed across the horizontal axis and subject areas are listed on the vertical axis. Within each cell block are listed page numbers of activities that deal with both the specific energy topic at the top of that column and the subject area at the beginning of that row.

## READING THE ACTIVITY

Each activity has an identical format. The most obvious section is the introductory box containing the Curriculum Topic (from your school district program) and the Energy Topic around which the activity was designed. To enhance your reading of the activities, each section of the activity format is described on the following mock-up of the activity.

14

| | |
|---|---|
| **Curriculum Topic** | as indicated. |
| **Energy Topic** | one of six energy topics. |
| **Grade Level(s)** | as indicated. |
| **Site** | location necessary to carry out activity. |
| **Skills** | skills exercised in the activity selected from the Taxonomy of Skills (See Appendix). |
| **Credit** | a source or person who made a significant contribution to the activity. |
| **Objective** | desired outcome in the learner following completion of the activity. |
| **To The Teacher** | substantive information to: 1) provide background for the presentation of the energy topic; 2) explain the connection between the curriculum topic and energy topic. |
| **Before You Begin** | preparations, materials, and cautions to consider before implementing the activity. |
| **Words To Know** | a list of key terms for the student (vocabulary). |
| **ACTIVITY** | as focal point of the activity, this section contains the step-by-step procedure for carrying out the activity. |
| **Related Activities** | various related activities as ideas for subsequent lesson plans and follow-up. |
| **Resources** | references used in developing the activity. |
| **Notes To Myself** | an empty section to be filled out by you. It is a place to make notes regarding your individual use of the activity. |
| **STUDENT PAGE** | pages referred to in the activity which can be duplicated and used by students for completion of the activity. |

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## TEST YOUR E. Q.

Score I for each correct answer. 0–5 Poor, 6–7 Fair, 8–10 Good.

ANSWERS:

1. (c) Approximately half of the gas used in a gas stove is used to fuel the pilot lights because pilot lights burn continuously.

2. (a) Fluorescent lights give off three to four times as much light per watt of electricity used as incandescent lamps do. One 40-watt fluorescent light gives more light than three 60-watt incandescent bulbs (and the annual savings may be as much as $10).

3. (c) Aluminum is a very energy intensive material with the largest share of the energy going to process the ore. Recycling is a great energy saver. The nation's total throwaway containers equivalent energy waste is equal to the output of 10 large nuclear power plants.

4. (b) If attic insulation were added to the 15 million single-family homes that need it, it would save about 8 percent of the heating oil previously used on a winter day.

5. (c) Ninety-four percent of the energy in the gasoline from crude petroleum is lost in the making your car move. The efficiencies of the most important steps where energy is lost are:

| | |
|---|---|
| producing the crude oil | 96% |
| refining | 87% |
| gasoline transport | 97% |
| engine thermal efficiency | 29% |
| engine mechanical efficiency | 71% |
| rolling efficiency | 30% |

The total efficiency of the system is found by multiplying the six factors together: 6%.

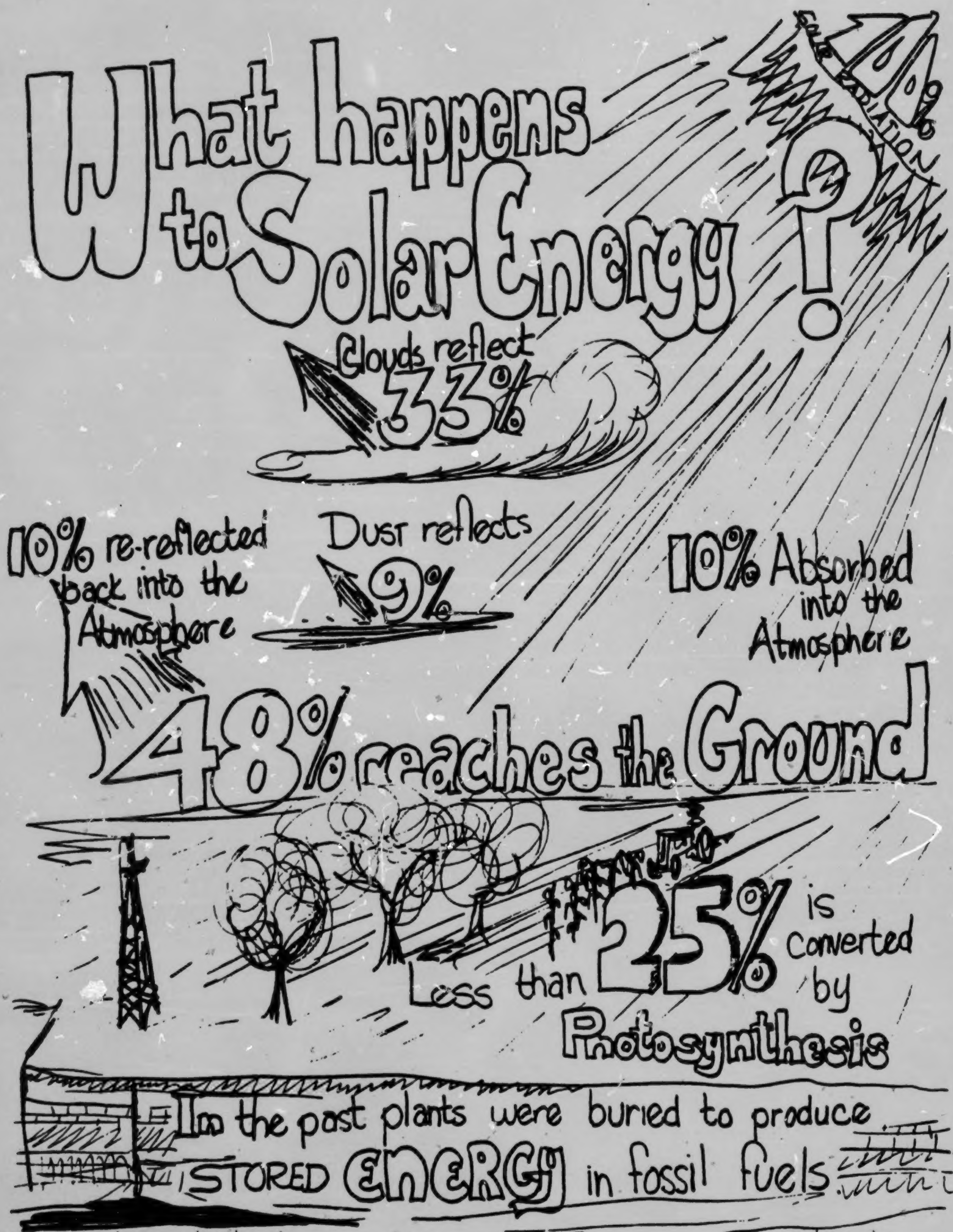
6. (b) 15 man-days of labor. Said in another way, one barrel of oil contains heat energy equivalent to the energy of a man at hard labor for 2 years.

7. (c) In less than 500 years man will have consumed essentially all of the coal, oil, and gas that nature started forming 500,000,000 years ago. By comparison, that same fraction of a calendar year is approximately 30 seconds.

8. (c) More than a third of the world's energy is consumed by the 6% of the world's population residing in the United States.

9. (b) For more than a century, American demand for energy has doubled, on the average, every 20-25 years.

10. (c) Natural gas reserves in the U. S. are expected to be exhausted in about 40 years. Petroleum should last for a century. Coal, 500 years or so.


SOLAR RADIATION 100%
What happens to Solar Energy ?
Clouds reflect 33%
10% re-reflected back into the Atmosphere
Dust reflects 9%
10% Absorbed into the Atmosphere
48% reaches the Ground
Less than 25% is converted by Photosynthesis
In the past plants were buried to produce STORED ENERGY in fossil fuels

# ENERGY - THE CONCEPT

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# ENERGY-THE CONCEPT

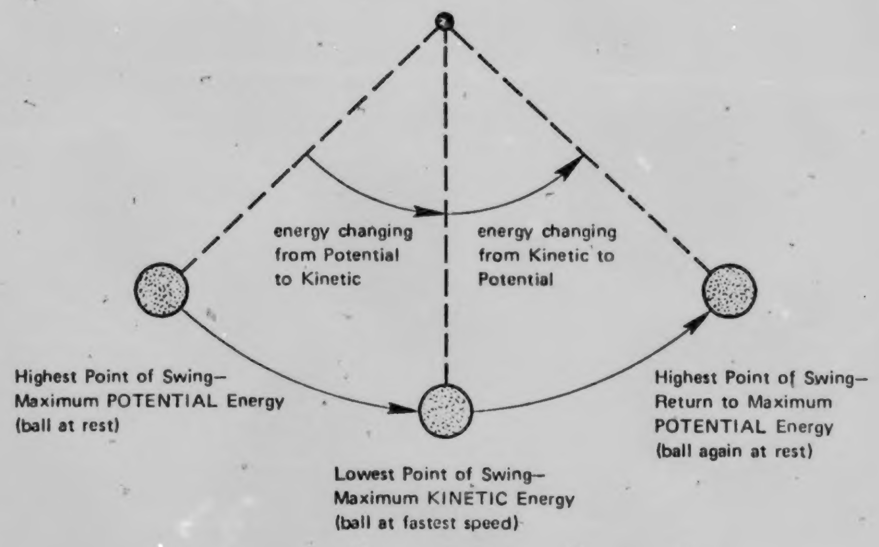
"Energy is a word used widely, but often with little thought. There are problems of meaning and problems in scale. Sheer energy in a television hosiery commercial may confuse youngsters, nor does it seem meaningful to equate that energy in a popular breakfast food with what the news commentators discuss when they consider new manifestations of the energy crisis (though, of course, food shortages and energy shortages are inexorably related). Frequently, students may be confused and apprehensive, perhaps even turned off. To turn them back on, and provide new awareness, it's practical to introduce energy thinking into other instructional areas, as well as science.

"How did the Pilgrims use energy? What energy sources did you use this morning in getting up and coming to school? What can you do each day to save energy, and how much can you save? What energy sources are used by the school?" These are some of the questions one can ask.

We all know that energy is the capacity or ability to perform work. What, then is work? Work, in physics, is a push or a pull (called a force) on an object which causes that object to move against a resisting force such as friction, gravity, or simple inertia. Since effecting movement is what we mean by work, obviously play is a kind of work, as are all human actions.

Any moving object is capable of performing work, and therefore possesses energy. We call this energy the energy of movement or kinetic energy. A rock falling from a cliff into a pool of water has kinetic energy due to gravity. Furthermore, any stationary object also possesses the capacity for moving and performing work, for it, too, is acted upon by gravity, which is opposed by a stronger resisting force keeping the object from moving. The stationary object, such as the rock on the cliff before the fall, possesses the energy of position or potential energy.

**Energy Transformations—A Pendulum**


energy changing from Potential to Kinetic
energy changing from Kinetic to Potential
Highest Point of Swing– Maximum POTENTIAL Energy (ball at rest)
Highest Point of Swing– Return to Maximum POTENTIAL Energy (ball again at rest)
Lowest Point of Swing– Maximum KINETIC Energy (ball at fastest speed)

Potential and kinetic are the two states of energy. An object at any given moment is either at rest or in motion; its energy is either potential or kinetic. Obviously, work is done only after an object passes from the potential state to the kinetic state, when its stored potential energy is released. A swinging pendulum illustrates the transformations of energy from potential to kinetic and back again.

Several different processes may bring about a change in the energy of an object from potential to kinetic. These processes are either mechanical (physical), chemical, or nuclear (atomic) in nature.

All of these energy-state transformations set something in motion which then has the capacity for performing work. The very first process is a nuclear process. The sun is a continuous source of nuclear and thermonuclear energy; it releases energetic nuclear particles and "waves" (photons) which continuously bombard the earth.

Much of this energy is absorbed by the earth's atmosphere. Some of it (sunlight) penetrates the atmosphere, where it strikes green plants which convert it to chemical energy by a natural process, photosynthesis. It is this natural process that is responsible for all the fuel we burn. Wood comes directly from green plants. Coal, oil, and natural gas are the fossilized remains of green plants and of plant and animal organisms which consumed them.

When chemical energy is used up, there is no actual loss of matter. That is, the combustion products of coal or oil weigh as much as the fuel did in the first place. But in the sun, matter is actually transformed into energy. And, as we learn from science, the possible energy yield from converting matter is tremendous.

In the sun there are two processes, fission (the splitting of heavy atoms) and fusion (the combining of light atoms). We are beginning to use the fission process directly to produce heat in nuclear power plants. We have produced fusion energy so far only in the hydrogen bomb. Man's hope for ultimate plentiful supplies of energy rests on better control of the fission and fusion processes.

Except in a few cases, such as storage batteries, heat is always generated as an intermediate step between chemical energy and mechanical energy. Heat causes air, steam, or some other gas to expand, and the expanding gas sets something in motion. In nature, a cloud may be set in motion. In man's environment, the heat can be used to drive a piston or turn a wheel. No mechanical device even approaches being a perfect energy converter; some heat always is lost to the surroundings, and there are other losses when heat is generated by friction.

We get most of our electrical power from mechanical energy, requiring another conversion step and more friction losses. In a storage battery, chemical energy is converted directly into electrical energy but there still is some heat loss.

## Processes of Energy Transformation

| | | |
|---|---|---|
| **MECHANICAL**<br>**(physical)** | Force pushes or pulls on an object causing it to overcome resistance and move. Origin of force may be man, other animal, plant, wind, water, machine, heat, gravity, magnetism. | Examples: bowling ball strikes pins;<br>plant pushes up through soil;<br>tornado uproots tree;<br>milk is poured on cereal;<br>toaster pops up toast. |
| **CHEMICAL** | Two or more substances brought into contact under certain conditions cause reaction which moves something (often expansion due to heat generated). | Examples: effervescent tablet fizzes in water;<br>cake rises in oven;<br>match burns when struck. |
| **NUCLEAR**<br>**(atomic)** | Tremendous potential energy holding atomic nucleus together is transformed to heat and light and great expansion of air. Some matter is transformed directly to energy. Two processes: (a) fission or splitting of nucleus by bombardment with subatomic particles; (b) fusion or joining of two nuclei under great heat and pressure. | Examples: nuclear power plants, "atomic" submarines, atom bomb (all fission); sun's surface, hydrogen bomb (fusion). |

When potential energy is converted to kinetic energy, heat is evolved, plus possibly light and sound. Actually, heat is really a form of kinetic energy due, basically, to the increased movement of atoms in the substance that is heated. Because heat is a result of every energy transformation, and because any energy source can be converted into an equivalent amount of heat, the measurement for heat--the British thermal unit (Btu)--is used commonly to measure potential or kinetic energy. One Btu is the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit. There are about 13,000 Btu in a pound of bituminous coal, 1,032 Btu in a cubic foot of natural gas, 132,000 Btu in a gallon of gasoline, and 145,000 Btu in a gallon of home heating oil.

When one state or form of energy is derived from another, we have energy-to-energy conversions; these are happening all the time around us (and even inside of us). The one important thing to remember is that you get only as much out of an energy-to-energy-conversion as you put in; only the forms or states of energy are changed when energy is converted from one form to another. There's no such thing as getting something for nothing.

Of all energy conversions occurring all the time, only a very few will result in work useful to man. We increase the number of conversions that generate useful energy through converters called machines, which transform energy of one form, the *fuel*, into energy of another form, the *product*. An automobile engine converts, by burning, the fuel gasoline, a form of stored chemical energy, into the mechanical energy of motion. Our own bodies convert food into movement, heat, and all life processes. The excess heat and sound generated by an automobile engine are mostly waste energy, not useful to our purpose of moving from place to place.

The term *efficiency* of a conversion process or a machine refers to the ratio of useful product to the total amount of input (or output) As users or converters of vast quantities of energy, we are therefore concerned not only with the supply of energy available to us, but equally with the efficiency of our energy-conversion processes.

Electricity is clean, available instantly, and easily transmitted. Since 1950, generation of electricity in this country has increased by a factor of four. However, both the generation and transmission of electricity involve some waste energy. Generation of electricity--the conversion of fuel to electrical energy--is less than 50 percent efficient in even the most modern plants. In many of the older plants as much as two-thirds of the energy generated is lost as waste heat which is exhausted as "thermal pollution" through plant stacks and cooling water. Ten percent of the electricity actually generated is lost during transmission. Newly developed and costly means of transmitting electricity through chilled underground cables have the potential of reducing this loss measurably.

We have seen that all energy conversions--and all our sources of energy--can be traced back to nuclear energy in the sun."[1]

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[1] *Energy: A Teacher's Introduction to Energy and Energy Conservation*, Ohio Department of Education, Columbus, Ohio, 1975.

WHAT IS ENERGY?

## Curriculum Topic

Heat

## Energy Topic

Energy - The Concept
Energy Sources

## Grade Level(s)

K-1

## Site

Classroom, schoolgrounds

## Skills

Observing, problem-solving speaking

## Credit

Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, 1977.

## Objective

Students should be able to:

1. Demonstrate by running, jumping, and clapping, that through motion, heat energy is produced.
2. Explain that the heating source (radiator) in the classroom is also producing heat energy.

## To The Teacher

This short lesson introduces the student to the nature of energy. The difficult concept of nutritional energy -- the flow of energy through the food chain -- is handled in a way children of this age can comprehend. The chemistry of burning -- utilizing fuel, oxygen, and heat -- is presented in simple experiments that children perform, e.g., jumping, running. etc.

In addition, we see this lesson as one that helps to clarify the sometimes difficult concept that energy is used to heat, light, and move things. The classroom radiator can be used to demonstrate motion energy as heat.

## Words To Know

Energy, heat, motion

## Notes To Myself

# ACTIVITY

1. Have children run around the outside school field or skip around the room until they begin to tire. Ask: How do you feel? Why do you feel warm and tired? (You feel tired because you have been using a lot of energy. You used energy in your body to move and feel warm.)

2. Have students put a finger in their mouths, or put a hand under their clothes on their stomach, or under their arm. How does it feel? Help children understand our body is constantly using energy to help us keep warm, move, and grow.

3. Let's look around the room. Who sees something in the room that moves or makes us warm? (Clock, radiator, bell.) Have a volunteer go to a conductor of heat and put his/her hand just above it. Ask: Can you tell the class what you feel, or what you might feel, if the heat were on? What do you think is making the air move or feel warm? (Energy.)

We have heat in our bodies. The radiator has heat. Is there anything else in our room that gives off heat? (Lights should be suggested.)

5. Clarify some beginning ideas about the nature of energy by leading a discussion. You might begin by saying: There are many things in the world that we know are there, because we see them. But there are some things we cannot see. Energy is one of those things. How do we know energy is there? Who can tell me a way? Children will probably suggest some of the following: (a. We can run and jump. b. The radiator feels hot. c. The light fixture has light and heat.)

6. How close your eyes tight and imagine: If you could see energy, what would it look like? Now open your eyes and tell me what you saw. (Accept any answer the children give, since this question asks for an imaginative interpretation of the appearance of energy.) Ask children to close their eyes again and to imagine what energy feels like. (Accept all responses, but conclude the lesson with the idea that energy produces heat and motion.)

# SUN POWER

## Curriculum Topic

The Sun as an Energy Source

## Energy Topic

Energy - The Concept
Energy Sources
Energy Uses

## Grade Level(s)

K-2

## Site

Classroom, schoolgrounds

## Skills

Observing, speaking, listening with comprehension, concluding

## Credit

Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN 1977.

## Objective

Students should be able to:

1. Identify the sun as a source of energy.
2. Write and/or tape a story about the sun.

## To The Teacher

The sun is a primary source of energy for all plants on the earth. Plants use energy from the sun to combine minerals from the soil with carbon dioxide from the air to make starches and sugar. The process is called photosynthesis. Today we can collect the sun's energy in photocells or in glass covered boxes which are blackened inside. The photocells convert the sun's energy to electricity. The energy absorbed in the glass covered boxes (which are called "solar panels") can be used to heat water flowing over them in pipes or tubes. This hot water can then be stored for use, or used to heat a home.

## Before You Begin

You will need:

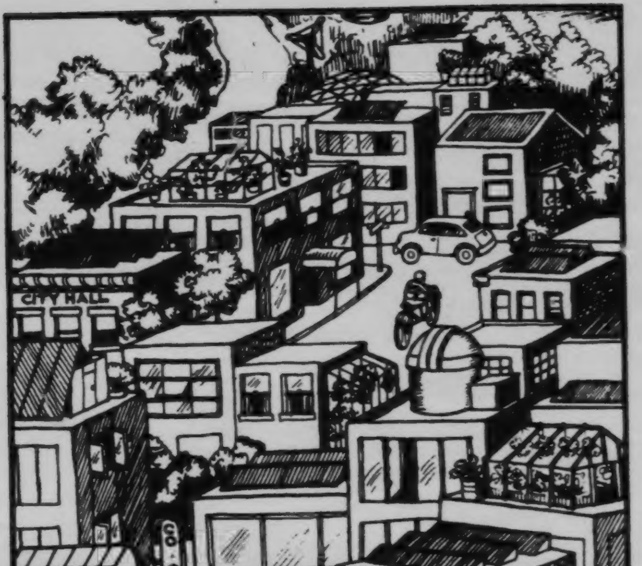
Box of cereal
2 samples of the same kind of plant

Note: A week in advance of the lesson put one plant in a dark place and a similar one in the light.

## Words To Know

Energy

## Notes To Myself



# ACTIVITY

1, A box of cereal may be held before the class. You may wish to say: I saw on TV a commercial for breakfast cereal. The announcer said that this breakfast cereal could give me energy. How could a breakfast cereal give me energy?

2. Another way of proceeding is to ask the children who have pets at home to stand. Do animals get energy from food also? (Call on each child who is standing.) Ask: What kind of pet do you have? What do you feed your pet? How does your pet use the energy in the food?

3. Begin discussing the following key questions:

If we get energy from food, and animals get energy from food, how do you suppose plants get energy? Are plants living things?

4. The sun gives light energy which is used by plants. Place the two plants in front of the class, the plant which was grown in the light and the one grown in the dark. Exaplin where each had been growing. Have the class observe differences. (The one grown in the dark is likely to be taller and a light shade, whereas the one in the light will be a healthy green color, bushier rather than tall and straggly.)

5. Compare the conditions for growth of the one in the dark with the one in the light. Bring out the fact that sunlight made the difference. Sunlight is necessary for the growth of most plants. We get light from the sun.

We also get heat from the sun. Did you ever get sunburned? If so, where did the heat come from?

6. Find other examples to show that the sun is a source of heat. Go outside and touch a wall that the sun is shining on. Now touch a part of the wall made of the same materials but in the shade. Which is hotter? If your children are learning to use thermometers, measure the temperature of the part of the wall in the sunlight and that in the shade. Compare.

7. Block one pane of glass with black paper so that the shadow falls on the windowsill. Put one hand on the sill where the sun is shining and the other in the shaded portion of the window sill. Which is better? Why?

## Related Activities

Make a class story giving some facts you have learned about the sun. It might include these:

OUR SUN

The sun gives light.
The sun gives heat.
Plants need sunlight in order to grow healthy.
Boys and girls need sunlight.

# ENERGY CONSERVATION

## Curriculum Topic

Family Life-Cooperation

## Energy Topic

Energy - The Concept
Energy Uses
Energy Conservation

## Grade Level(s)

K-3

## Site

Classroom, home

## Skills

Locating and obtaining information
Communicating information

**Credit** *Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy*, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, 1977.

## Objective

Students should be able to:

1. Tell how energy is helpful to them in their homes.
2. Suggest ways energy can be used wisely.

## To The Teacher

Energy benefits us in many ways. It warms and cools our houses and other buildings, provides transportation, and powers the many engines and processes of industry to improve our lives.

However, the resources needed for production and use of energy are in limited supply. Fossil fuels such as oil and natural gas are in very short supply. Conservation of energy resources is essential. But conservation will require a change in our attitudes and lifestyles. Turning off lights, driving fewer miles, turning down the thermostats, are common ways to save energy. The point of this lesson is that conservation works only when everyone cooperates.

## Before You Begin

You will need the following materials for each student: pencil, crayons, 2 sheets of manila paper (18" x 24"), copy of home energy checklist (optional).

# ACTIVITY

1. Ask: Can someone say how energy helps us here in our classroom? In our school? Can you think of another place where energy is helpful to us? (Home) How is energy helpful in our homes? (Have children give examples.)

2. Develop the lesson by asking if there are other ways energy is used in our homes. Distribute manila paper to each child. Say: Fold your paper in half lengthwise. (Show them.) Fold it in half crosswise. How many rectangles do you have? (4) Let's pretend each is a room in your house. (These four rooms should be stated: bedroom, bathroom, kitchen, living room. If you wish to do so, you may add other rooms on the other side of the paper.) As children say the name of each room, print it on the board for them to see. Have the children copy a name on each square.

3. Ask the students to take this paper home and draw as many energy helpers in each room of their house as they can. Who could help them with ideas? Encourage the students to get their parent's help.

4. During the next class, draw four sections on the chalkboard and label them kitchen, bedroom, living room, and bathroom. Discuss each room in turn asking what energy helpers the children found in it. As each energy user is mentioned, have a child draw it on the board.

5. Pull the entire lesson together with a statement similar to this one: Look at all the things we found that are energy helpers. These energy helpers are also energy users. Just think how much energy they use when people in every home turn these things on.

Most of the energy we use comes from our fossil fuels that took so long to be made. We want to make sure that they don't run out. How can you help? (Accept and discuss the suggestions the children give.)

6. Distribute another large sheet of manila paper. Have each child draw one way to save energy. Use their pictures for a bulletin board.. Suggestions may be:

| | |
|---|---|
| After use, turn off: | Lights<br>Radio<br>TV<br>Electric blanket<br>Faucets<br>etc. |
| Turn down: | Air conditioner<br>Furnace<br>etc. |
| Use less energy: | Push mower instead of power mower<br>Take fewer car trips<br>Bicycle instead of car<br>Carpool<br>etc. |
| Save energy by: | Closing doors and windows when air conditioner is running.<br>Insulate around windows, doors, and attics for cold weather.<br>Closing refrigerator door quickly.<br>etc. |

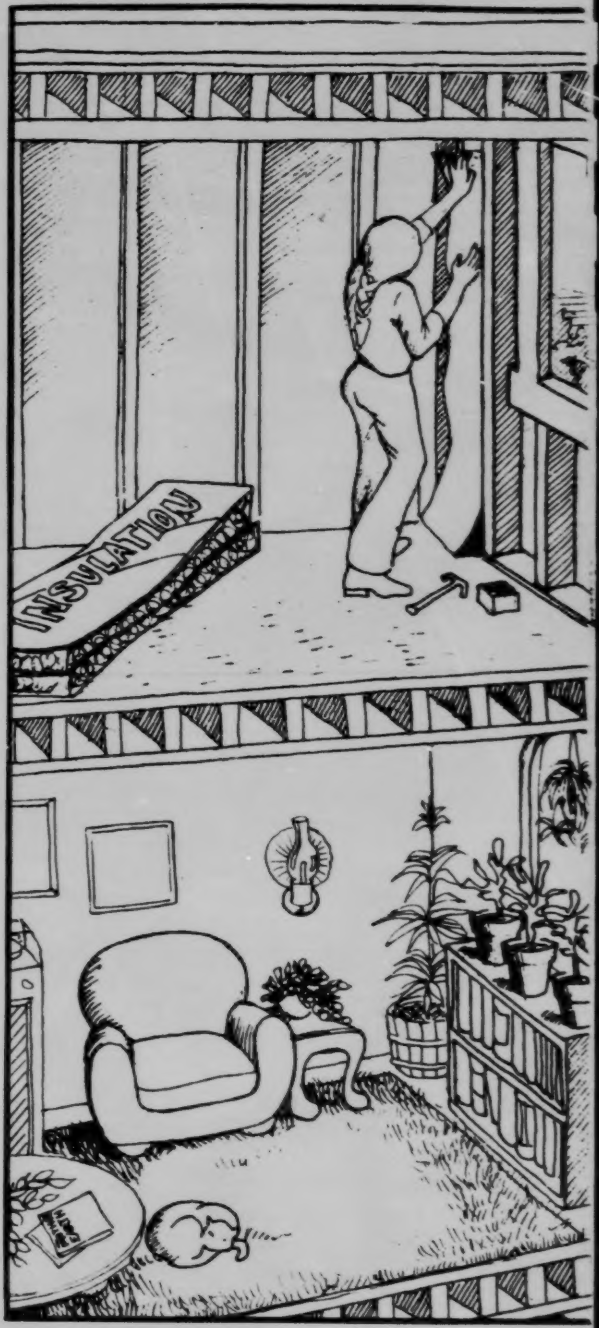
## Related Activities

1. Have a fifth or sixth grader demonstrate a simple circuit using a dry cell and a light bulb. Add extra light bulbs to the circuit. Notice what happens to the amount of light given off by each bulb as another is added. (Less until they go out.)

2. There is a certain amount of energy in the world. When the energy source is used up, there is none left. We need to help save our energy.

Make a home checklist such as the one on page 36. Have your class add other items to the list. Then, take it home for a week to check it.

## Notes To Myself



33

# STUDENT PAGE

| HOME ENERGY CHECK LIST | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|---|
| 1. Turn off the light. | | | | | | | |
| 2. Turn off the thermostat (with Mother's permission). | | | | | | | |
| 3. Walk to the store. | | | | | | | |
| 4. Turn off the faucet to stop the drip. | | | | | | | |
| 5. Take a short shower instead of a bath. | | | | | | | |
| 6. Pull drapes or curtains to keep the house warm at night. | | | | | | | |
| 7. Close storm door tightly to keep out drafts. | | | | | | | |
| 8. | | | | | | | |
| 9. | | | | | | | |
| 10. | | | | | | | |

# Solar Cooking

## Curriculum Topic

Indians - The Northeast
Woodland Indian
U.S. History
Energy Forms

## Energy Topic

Energy - The Concept
Energy Sources
Energy Uses

## Grade Level(s)

3-5

## Site

Classroom, outdoor sunny area

## Skills

Constructing models, experimenting

**Credit** Oklahoma Energy Awareness Education, Oklahoma State Dept. of Education, 1977. Adapted by Antoinette R. Giovannitti and Arthur C. Braun, Jr. in EARTHWATCH, Vol. I, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT, 1978.

## Objective

The child will be able to propose ways in which direct sunlight can meet some of our energy needs. The child will also explain how solar energy, by reflection, can be used to cook food.

## To The Teacher

American Indians of the Northeast were farmers and hunters of the woodlands. They knew nothing of the tepee, but lived in wigwams. The Iroquois, who called themselves the people of the "Long House," built long huts (c. 100 feet) which had bunks and a central row of fireplaces.

The designs of shelter, divisions of labor, clothing, food and daily activities of these Indians were determined by the natural environments of the regions in which they lived.

The sun was necessary for his existence. Its energy was used to grow crops for man and food for local wildlife, or to prepare animals and plants for the long, hard winters.

## Before You Begin

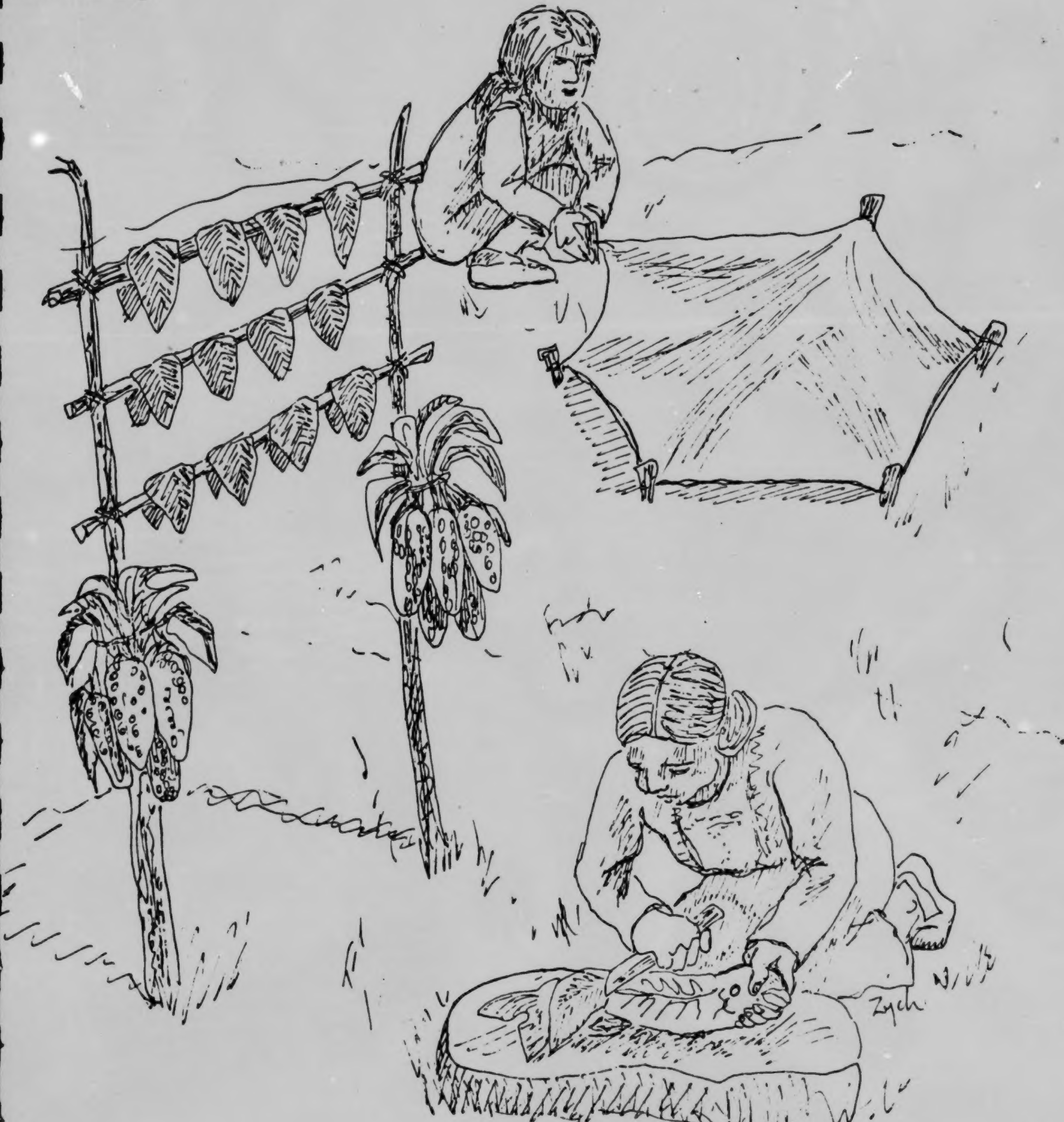
large paper clips, rubber cement, poster board, aluminum foil, black skillet, oven thermometer, food to cook (egg)

**Cautions:**

Advise children not to look directly into the sun because it can cause permanent damage to their eyes.

## Words To Know

energy, reflector, natural environment, venison, preserve, edible, efficiency



# ACTIVITY

1. After a lesson on Indians, ask the following questions:

a) In what ways did the Indians cook their food? (central open fires)

b) In what ways did they use the sun? (to preserve venison and other animal meats and fish)

c) The native Indians used the sun as a means of cooking and heating. How might we, today, follow their example?

d) How can we make a cooking device which will use the sun for energy?

2. Proceed to make a reflector for cooking food.

a) Open the umbrella and measure its panels. Cut new panels out of poster board large enough to slightly overlap.

b) Cover each poster with heavy-weight aluminum foil held by rubber cement. Use paper clips to mount the panels inside the open umbrella.

c) Cut off the handle of the umbrella to the same length as the radius of the umbrella. (A string may be used to measure the diameter). Example: If the diameter of the umbrella is 30cm, then the length of the pointer should be 15cm (radius = $\frac{\text{diameter}}{2}$)

d) Use the handle to direct the umbrella toward the sun. The hottest spot inside the umbrella is called the focal point.

e) Put the skillet over the focal point. Fry an egg.

f) To increase the efficiency of your solar cooker, in a paper plate the size of the pointer, cover the plate with foil and lay it over the pointer pushing it down to the center of the umbrella. This will help hold the panels in place.

3. Discussion question:

a) How long did it take to cook the food?

b) What are the advantages and disadvantages of using the sun's energy to cook food? (inconsistent source of heat)

c) Can solar energy be used regularly to cook foods in the future? (Yes, necessity for new forms of energy and increased technological development in this area encourage the possibility of more widespread use of solar energy.)

d) What are other uses of solar energy?

## Credit

Oklahoma Energy Awareness Education, Oklahoma State Department of Education, 1977

Shapiro, Irwin, The Golden Book of America, Golden Press, New York, 1961

Drawing: Cecelia Zych

# Let's Power Spaceship Earth With the Sun

## Curriculum Topic

Energy Forms: Solar
Earth Science
Astronomy

## Grade Level(s)

4-6

## Site

Classroom

## Skills

Reading, locating and obtaining information

## Energy Topic

Energy Sources
Energy Uses
Energy - The Concept

## Credit

"The Energy Challenge," U.S. Dept. of Energy, 1976. Adapted by Ed Lisk in EARTHWATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT, 1978.

## Objective

Students will be able to:

1. recognize and cite the magnitude of the sun as an energy source
2. illustrate ways by which people throughout history have depended on the sun's heat and light.

## To The Teacher

The sun, the great star of our astronomical system, is the source of almost limitless energy. The sun's energy is thermonuclear in origin. That is, the core of the sun is hot enough to bring about a nuclear reaction, in the course of which tremendous amounts of energy are released into space in the form of rays or waves of radiation. Visible light, heat, and radio waves pass through the earth's atmosphere in amounts appropriate to sustaining life on earth. The outer ozone layer of the atmosphere, which is created by the sun's action on oxygen molecules, is, for life on Earth, a protective layer against lethal solar radiation such as excess ultraviolet radiation.

You can demonstrate the rays of visible light waves by shining a beam of sunlight through a prism or even a drinking glass full of water. The seemingly yellow-white light will break up into rays of violet, blue, green, yellow, orange, and red. Remind students that they have seen these light rays in a rainbow.

The sun heats the land and the oceans and creates the great currents, the wind and the waves. It provides energy for evaporation, a step without which the Earth's carefully-modulated water cycle would be broken. Water that falls as rain feeds the rivers and the streams which turn water wheels and turbines of hydroelectric plants. Radiant energy is changed to stored chemical energy by the process of photosynthesis that takes place in the cells of green plants. It is this chemical, potential energy that is stored in coal, oil, and natural gas.

After completing the student pages of this activity, students will be able to understand our reliance on the energy of the sun in an historical context. Students identify items of a list as direct or indirect products of the sun's energy. Several discussion questions are included which are designed to urge the class to imagine a future life in which power will come from a major non-polluting, inexhaustible energy source. Ask students to consider that while solar energy as a major energy source is attractive, the cost of developing technology for implementing it is great.

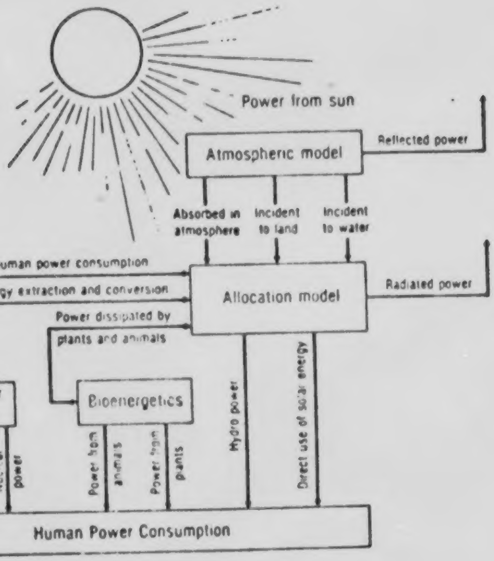
## Before You Begin

Materials: copies of Student Pages

## Words To Know

energy, generator, ozone, photosynthesis

Global Energy Model


Power from sun
Atmospheric model
Reflected power
Absorbed in atmosphere
Incident to land
Incident to water
Waste heat from human power consumption
Waste heat from energy extraction and conversion
Allocation model
Radiated power
Power dissipated by plants and animals
Human power generation
Bioenergetics
Hydro power
Direct use of solar energy
Fossil fuel power
Geothermal power
Nuclear power
Power from animals
Power from plants
Human Power Consumption

# ACTIVITY

1. Distribute Student Pages.
2. Ask students to read and complete the worksheets.
3. Discussion questions:
   a. Why is the sun called the source of all but nuclear energy?
   b. Imagine future life on earth when we have learned to harness the power of the sun to provide heat, light and electricity. What problems would be solved? What problems might be created?
   c. Discuss the order of changes which would ovvur if the sun stopped shining.
   d. Discuss the benefits provided to us by using more of the sun's energy directly.

Answers to Student Worksheet

| | |
|---|---|
| D | coal deposits |
| I | sail boats |
| D | salt flats |
| I | gasoline |
| D | photosynthesis |
| D | mountain streams |
| I | Hoover Dam |
| D | sugar cane |
| I | candy bar |
| I | electric heater |
| D | leaves turning green |
| D | ocean currents |
| I | steam engine |
| D | ozone layer of the atmosphere |

## Related Activities

1. Build a solar collector.

2. Take a survey among the class to determine the forms of energy source used to heat their homes.

3. List all the different forms of energy individual students use in one day.

## Resources

Clark, Wilson, Energy for Survival, Anchor-Press, 1975.

Turk, J., et al, Ecosystems, Energy, Population; 1975, Saunders Company.

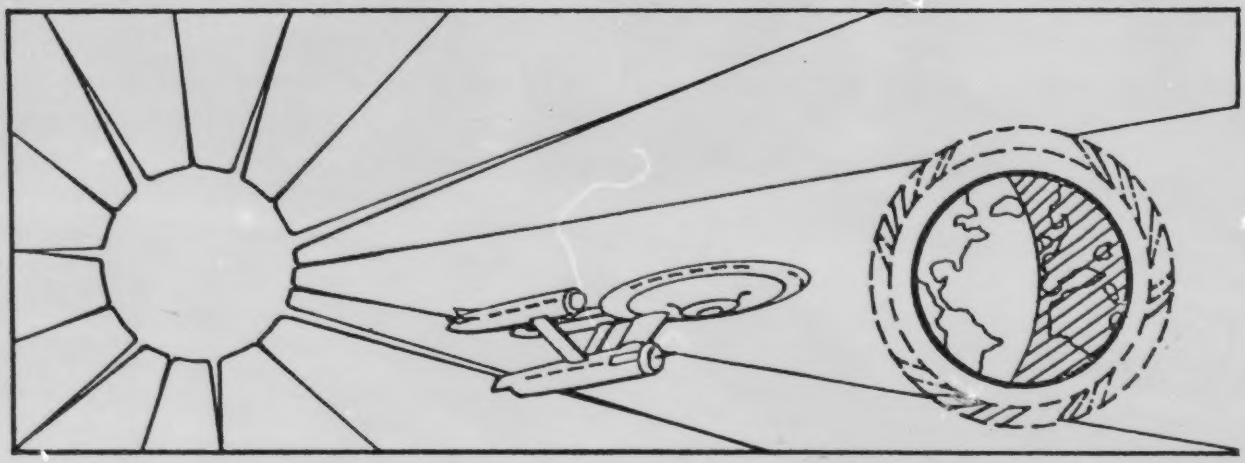
Energy Primer, Portola Institute; Fricke-Parks Press, 1974.

"Fact Sheet", National Science Teachers Assoc., Oak Ridge, TN, 1977.

## Credit

*This is largely excerpted from "The Energy Challenge", U.S. Dept. of Energy, Worksheets from Activity #12, 1976

# STUDENT PAGE



## *Let's Power Spaceship Earth With the Sun*

The sun, 93 million miles away from earth, sends more radiant energy toward us every second than people have used in the course of human history. Thirty percent of this energy is reflected back into space by our atmosphere. Much of the remaining radiant energy of the sun heats the land and the water; it evaporates water and melts the snows. It is the source of energy that creates the winds and great ocean currents, and it warms the atmosphere that surrounds us.

Energy from the sun interacts with oxygen at the top of the earth's atmosphere to create a layer of ozone that protects us from lethal amounts of the sun's radiation. Solar energy reacts with plants in the chemical process of photosynthesis to provide the stored energy that fuels life. Coal and oil and natural gas, once swamp jungles of the ancient earth, are stored solar energy. All of these are ways we benefit from the sun's energy directly.

We also benefit indirectly from the sun's energy when that energy comes to us "secondhand." The electricity generated by a windmill, for example, is the sun's energy once removed. So, too, is the energy our bodies get from the food we eat.

Less than one percent of the incoming solar energy is used to sustain plant and animal life, yet this amount is many times greater than the total electric generating capacity of the entire world. the sun could be an important answer to our energy dilemma. All we have to do is find the key to the bank.

Humans from the dawn of history have put the energy from the sun to work to keep warm or to grow food, or by harnessing the wind. In what ways did early people use the sun to do work for them?

What has the energy from the sun made possible in your life today?

Put a D beside each of the following things that result from energy received directly from the sun. Put an I beside each thing that results indirectly from the sun's energy.

—— coal deposits
—— sailboats
—— salt flats
—— gasoline
—— photosynthesis
—— mountain streams
—— Hoover Dam

—— sugar cane
—— candy bar
—— electric heater
—— leaves turning green
—— ocean currents
—— steam engine
—— ozone layer of the atmosphere

# Energy Timeline

### Curriculum Topic

Industrial Revolution
U.S. History

### Energy Topic

Energy Sources
Energy Uses
Energy - The Concept

### Grade Level(s)

6

### Site

Classroom

### Skills

Reading
Locating and obtaining information

**Credit** "The Energy Challenge", U.S. Department of Energy, 1976 Adapted by Ed Lisk, in EARTH-WATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT 1978.

## Objective

Students will be able to make a timeline to show 200 years of the development of enery development resources.

## To The Teacher

This activity provides a comprehensive introduction to the modern energy story from the time of James Watt's contribution to the steam engine in 1776 to the demands for energy development today. Each activity sheet includes four 25-year segments, which can later be cut apart and joined into one long timeline. By gathering facts from encyclopedias and classroom discussion to complete the statements on the timeline, students will quickly gain an historical framework in which to consider the concerns of the present day energy situation. They can conclude that the changes in lifestyle depicted in bold type in each 25-year segment, growth in population, and the demand for goods and services are contributing factors to our growing energy dilemma. But you can help them see that humans have always been problem-solvers and that human inventiveness can help us continue the progress we began in this country 200 years ago.

## Before You Begin

1. Make copies of student pages.

2. Provide reference materials.

# ACTIVITY

1. Distribute Student Pages, "Finish the Energy Timeline."

2. Direct students to research information on the various topics and complete their worksheets by filling in the blanks.

3. Instruct them to make a continuous timeline by cutting along the dotted lines and taping the sections together.

4. Ask students to research other events (wars, famous people,etc.)

Answers to Student Worksheets are as follows:

1776 - steam, 1783 - Paris, France and hot air, 1800 - Volta and electricity, 1804 - Trevithick, 1807 - steamboat, 1829 Joseph Henry, Michael Faraday, Henry, electricity, 1837 - reaper, Otis, Morse, 1859 - petroleum, 1860 - internal, 1884 - turbine, 1886 - Benz, 1892 - Rudolf Diesel, 1895 - electricity, 1903 - gasoline, 1905 - atomic, 1910 - T, 1926 - rocket, 1936 - hydroelectric, 1940 - nylon, 1942 - nuclear, 1952 - solar, 1957 -nuclear, 1970 - clean, 1973 - embargo, 1976 - conserve, energy

5. Place one timeline in the center of a bulletin board. Have each student illustrate one event from the timeline. When the illustrations are complete, tack them on the bulletin board around the timeline. Use a string or yarn to connect illustration of event with year on timeline.

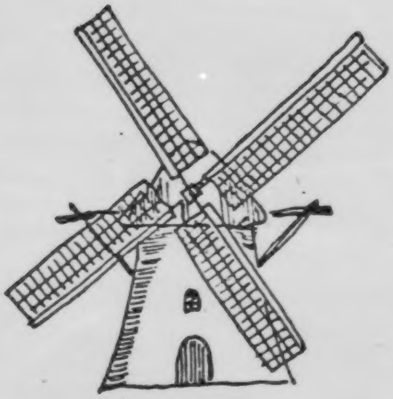
6. Discussion questions:

A. What energy form was used the most in the 1700's?, 1800's?, 1900's?

B. Has the rate of progress in the development of energy resources always been the same?

C. How has transportation changed as new energy forms and supplies have become available?

D. Relate the changes in industry to the availability of energy supplies.



## Related Activities

1. Assign the students to trace a particular industry or occupation from the year 1776 to 1978.

2. Ask students to make model steam engines or batteries.

3. Ask students to make models of the diesel, Wankel jet or internal combustion engine.

## Resources

Hayes, Carlton J., and Margareta Faissler, Modern Times, Collier-MacMillan, 1965, Chapter 15.

Leinwand, Gerald, The Pageant of World History, Allyn and Bacon, 1974, Chapter 22.

Those Inventive Americans, National Geographic Society, Special Publication Division, 1971.

Platt, Nathaniel, and Muriel Drummond, Our World Through the Ages, Prentice-Hall, 1967, Chapter 16.

## Credit

This activity is largely excerpted from U.S. Department of Energy, 1976, "The Energy Challenge,"

## Words To Know

energy, combustion, generator, steam, turbine

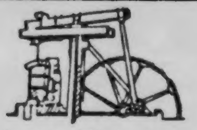
## Notes To Myself

# *Finish the Energy Timeline*

Activity Master 1

cut

1780 1785 1790 1795



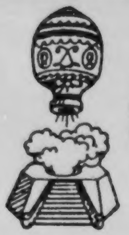
**1776**

In England James Watt puts two engines to work in factories & starts an energy revolution. The energy is

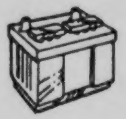
**1783**

Two men fly in a balloon at

The energy used is



**Most people burn wood for heating and cooking and travel by horse or on foot.**



**1800**

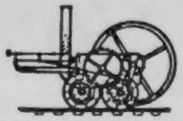
In Italy, invents the battery and gives his name to the volt. The energy produced is

cut

1800 1805 1810 1815 1820 1825

**1804**

An Englishman Richard

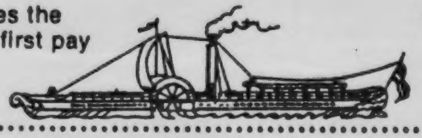


puts James Watt's engine on wheels and rails. He is the father of the railroad locomotive.

**1807**

Robert Fulton doesn't build the very first

but he makes the one people first pay to ride on.



**Wood continues to supply most household energy needs. But coal begins to do more in factories and railroad engines.**

**1821**

First attempt to develop and market natural gas near Fredonia, N.Y.

cut

1830 1835 1840 1845

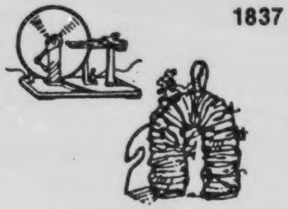
**1829** An American named

and an Englishman named

each invents a generator.

Who is first?

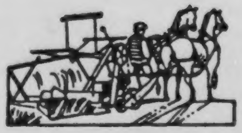
The energy produced?



**1837** Americans put new inventions to work. First comes McCormick's

then the steam shovel by and

the telegraph by



**Railroads expand rapidly, hauling freight and passengers brave enough to stand the jolts and to risk hot cinders that often fly from the engine into their cars. England is first and America second in railroad locomotive production.**

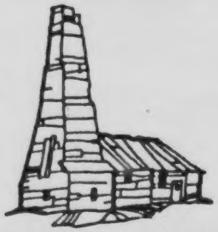
cut

1850 1855 1860 1865 1870 1875

**1859**

Edwin Drake strikes oil in Pennsylvania beginning the

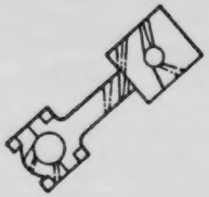
industry.



**1860**

Lenoir of France invents the

combustion engine.



**An explosion inside a cylinder paves the way for the later invention of the automobile. An oil strike hastens the discovery of the fuel that will run it.**

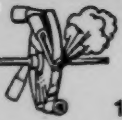
cut

cut

1880 1885 1890 1895

**Coal and wood still furnish most of the energy in homes. "Iron horses" and real ones continue to take most people places. Although the electric bulb has been invented most people still use kerosene or gaslights to read by.**

**1884**
In England, Charles Parsons perfects the steam
and advances the development of electrical energy.



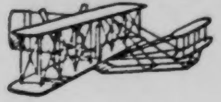
**1886**
Karl
builds the 1st successful automobile.

**1892**
The oil-burning engine is invented by
Eventually, this engine will replace steam-powered ones.

**1895**
The power of Niagara Fall is harnessed to make

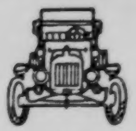
cut

1900 1905 1910 1915 1920 1925



**1903**
The engine in the Wright brothers' plane is powered by

**1905** Albert Einstein develops a theory for measuring energy and prepares the way for the
age.



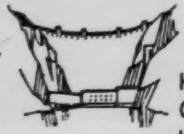
**1910**
Ford makes the first Model
car.

**By the end of this period, many new homes have coal furnaces in the basement. And more and more cars appear in garages.**

cut

1930 1935 1940 1945

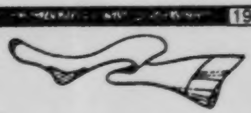
**1926**
Robert Goddard tests a



**1936**
Hoover Dam on the Colorado River is built to generate

power.

**1940**



a
fiber made from oil, coal, and water makes its first public appearance.

**1942**

In Chicago, Enrico Fermi sets off the first

chain reaction.

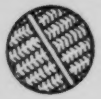
**Many homes convert from coal to natural gas for heating. Most families own at least one car and some have two.**

cut

1950 1955 1960 1965 1970 1975

**1952**
Bell scientists raise hope for our energy future with the

battery.



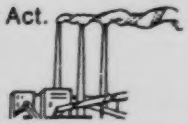
**1957**
The U.S. gets its first big

electric power plant at Shippingport, Pa.

**Demands for energy grow. America gets more people, more homes, more factories and businesses, more cars, more trucks, more buses, more planes. Demand grows faster than supply.**

**1970**
Congress passes the

Air Act.



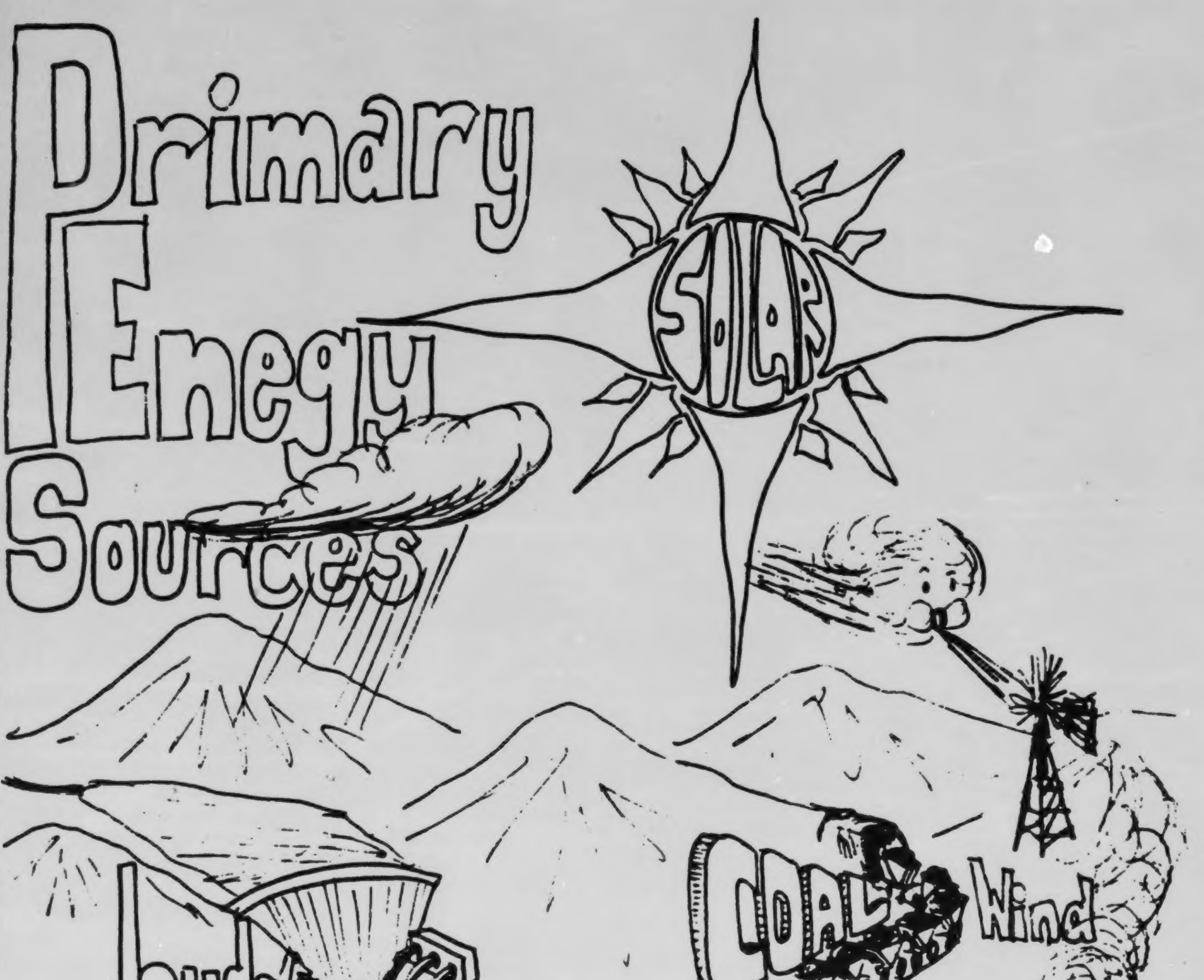
**1973**
OPEC nations

oil and produce an energy crisis.

**1976** Americans continue to look for ways to

the energy we have and find new sources.

cut


Primary
Enegy
Sources
SOLAR
hydro
COAL
Wind
OLD FAITHFUL
Geothermal
Oil
Nuclear
PETROLEUM AND Natural Gas

# ENERGY - SOURCES

Activity Title | Page Number
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## ENERGY SOURCES

Most systems, both natural and human, are built and maintained by a combination of natural and developed energy sources. (Energy, in this context, includes not only natural and humanly developed sources, but also materials, goods, and services which also contain forms of energy.) When energy resources are plentiful, most systems increase their assets and growth; when energy resources are in short supply, activities decline and the systems then use available energy for maintenance rather than growth or construction.

To help you track an individual energy resource through its delivery process, we present a brief introduction to the various types of sources. As an integral part of any assessment of energy delivery and its use, it is necessary to understand the nature of the sources and their current and possible uses. The development of most energy sources often involves difficulties in extraction or collection, or significant environmental costs to natural or human systems either during or after obtaining them.

### a. Distinctions Between Energy Sources

Some resources exist in a natural state and some are by-products of other activities in our society. We can define two categories of energy resources:

- Non-Renewable: The use of these resources is dependent on the amount of supply in existence. These finite reserves are made available to society as a function of available technology and capital investment.
- Renewable: The use of these resources is determined by their rate of renewal. These infinite reserves are available at specific rates to humanity depending upon specific locale; their availability as an energy resource is also a function of available technology and capital investment.

The following chart lists these renewable and non-renewable energy resources:

| NON-RENEWABLE ENERGY RESOURCES | RENEWABLE ENERGY RESOURCES |
|---|---|
| Fossil Fuels | Solar Energy |
| Petroleum | Fresh Water |
| Natural Gas | Wind Power |
| Coal | Oceanographic |
| Oil Shale | Tidal Power |
| Tar Sands | Thermal Gradient |
| Nuclear Energy | Geothermal Energy |
| Fissionable Materials | Steam |
| Fusionable Materials | Heat |
| | Biomass |
| | Life Forms |
| | Human Work |
| | Photosynthesis |

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The most important distinctions between these types of resources are summarized below:

| NON-RENEWABLE RESOURCES | RENEWABLE RESOURCES |
|---|---|
| . Exist in the earth in limited quantities that could conceivably be used up. | . Will be available so long as the earth ecosystem continues to function. |
| . Comprise forms of high quality energy that have been historically easier to collect and use. | . Tend to be of higher entropy and require more effort and energy input for collection and use. |
| . Constraints on availability arise from the necessary energy required to pump or dig them up. | . Available for use as fast as they are supplied by the natural system--for example, more wind or sunlight cannot be collected than passes through an area during a day. |

### b. Types of Energy Sources

Those energy sources which currently yield most of our energy supply are here referred to as "conventional" energy sources. Other sources, either contributing on a small scale or being explored as to availability and potential large-scale contribution are termed "non-conventional" sources.* Following are tables summarizing the nature of these energy sources. The first six are considered "Conventional" - the latter (6-18) are considered "Non-Conventional." The sources listed in the tables are:[1]

"Conventional" Energy Sources

Major
- (1) Petroleum
- (2) Natural Gas
- (3) Coal

"Non-Conventional" Energy Sources

- (6) Oil Shale
- (7) Tar Sands
- (8) Coal Gasification
- (9) Geothermal Energy

*Executive Office of the President, Energy Policy and Planning, The National Energy Plan. Washington, D.C.: U.S. Government Printing Office, April 29, 1977, p. xiii.

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[1] Largely based on Energy Resource Delivery And Use, Far West Laboratory for Educational Research and Development (Field Test Version), 1978.

"Conventional" Energy Sources

Minor
- (4) Hydroelectric Power
- (5) Nuclear Fission
- (6) Wood

"Non-Conventional" Energy Sources

- (10) Solar Energy
- (11) Tidal Power
- (12) Wind Energy
- (13) Hydrogen
- (14) Fuel Cells
- (15) Magnetohydrodymanics (MHD)
- (16) Burning of Trash
- (17) Nuclear Fission (Breeder)
- (18) Nuclear Fusion

## *A Look at future energy alternatives . . .*

|  | PRESENT USAGE | LIFE OF SUPPLY | ADVANTAGES | DISADVANTAGES |
|---|---|---|---|---|
| **OIL**<br>A fossil fuel | 47%<br>(1990:45%) | 8 to 35 years* | Versatile and easy to transport. | Nonrenewable; only 50% of U.S. supplies produced domestically; imports cause economic, security problems; new sources costly to develop; spills, blowouts cause pollution. |
| **NATURAL GAS**<br>A fossil fuel | 27.5%<br>(1990: 15%-20%) | 13 to 30 years* | Clean burning; Permits precise heat regulation. | Nonrenewable; domestic supplies declining; future supplies uncertain. Liquified natural gas hazardous to store and transport. |
| **COAL**<br>A fossil fuel | 18.6%<br>(1990: 20%-25%) | 600 years*<br>⅓ of world's coal reserves | Largest fossil fuel resource. Convertible to substitute natural gas and oil. | High pollution control costs from acid mine drainage and environmental problems. Mine safety problems. Land subsidence; a need for careful reclamation. |
| **NUCLEAR**<br>Electricity from uranium and other nuclear fuels. | 2.7%<br>(1990: 10%) | 30 years*<br>(without breeder) | Clean with no odors. High yield from small quantity of fuel. | Possibility of radiation leaks; difficulty of waste disposal; thermal pollution; high construction costs. Future costs of fuel uncertain. |
| **HYDROELECTRIC**<br>Electricity from water power | Small | Inexaustible | Clean, nonpolluting | Environmental effects on rivers. Most sites already developed. Limited capacity, expensive. |
| **OIL SHALE**<br>Processing organic and lake bed sediments | 0.0% | Unknown | Very large supplies | Difficult and expensive to develop; Water scarcity; air pollution; possible carcinogenic effect on workers. |
| **SOLAR**<br>Harnessing the heat of the sun | .01% | Infinite, but potential limited by market and weather. | Clean, nonpolluting | Problem of aesthetics, land use; capital costs uncertain. Storage technology uncertain. |
| **WIND**<br>Utilizing the wind's energy | Small | Infinite | Clean, nonpolluting | Problems of aesthetics, land use and possible weather modifications; capital costs and storage technology uncertain. |
| **GEOTHERMAL**<br>Harnessing the earth's internal heat | Small | Inexhaustible but limited geographically | Economical and cost competitive where available. | Geographic limitations; land subsidence; some air and water pollution. |
| **BIOCONVERSION**<br>Harnessing the energy in plants or in waste products | Small | Unlimited | Available; well developed for small-scale wood & organic waste burning. | Experimental; impact on land and water use; problem of aesthetics; large systems not yet cost competitive. |
| **OCEAN THERMAL ENERGY CONVERSION**<br>Harnessing the oceans' solar heat | 0.0% | Infinite | Available | Expensive and experimental; problem of aesthetics; navigational hazards and climatic changes possible. |

*Based on proven reserves at current rates of consumption.

Source of statistics: League of Women Voters, U.S. Department of Energy

ENERGY FROM FOOD

## Curriculum Topic

Nutrition
The Body

## Energy Topic

Energy Sources
Energy Uses

## Grade Level(s)

K-1

## Site

Classroom

## Skills

Locating and obtaining information, communicating information

**Credit** Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN 1977.

## Objective

Students should be able to:

1. Match various cereal grains with processed food that is made from these grains.
2. Recognize that when food is digested, it becomes a source of energy and that we need more food energy when we are more active.

## To The Teacher

Food energy is stored in nutrients (proteins, carbohydrates, fats). During digestion these nutrients are broken down into forms usable by the body. After this process is completed in the small intestine, the end products of digestion pass into the bloodstream and are transported to the body cells. Here the food is used to produce energy in the complex process of cellular respiration.

## Before You Begin

You will need the following materials:

Pencils Paper Crayons

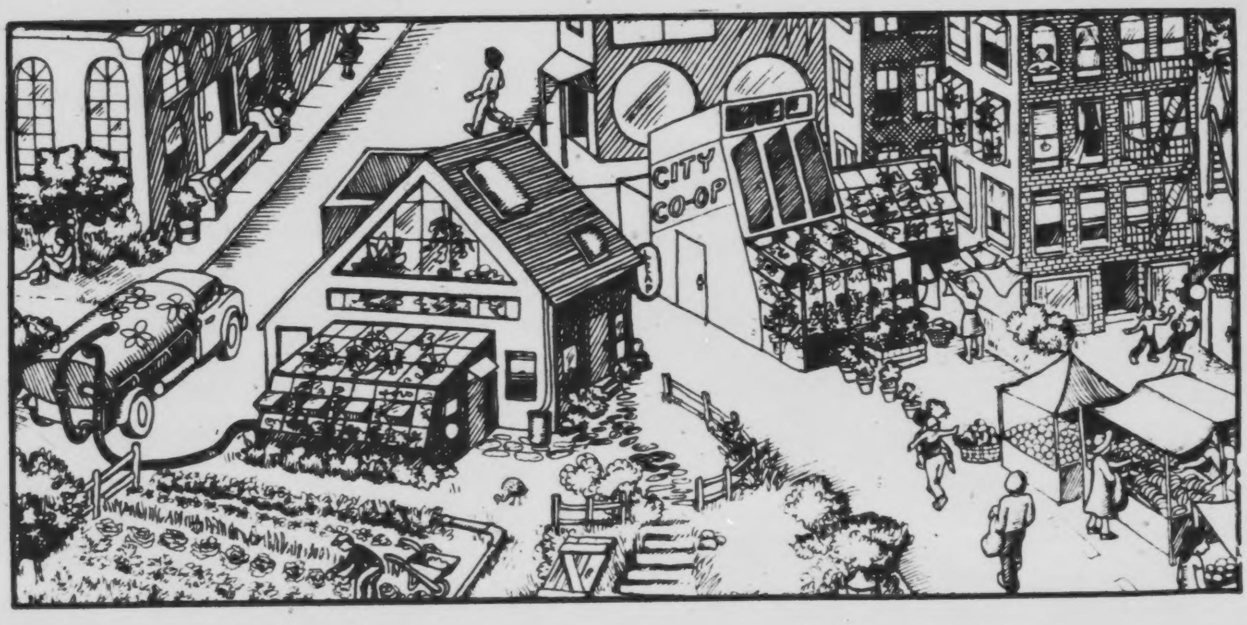
Seed samples of wheat, oats, barley, rice, corn, millet -- each in a separate bowl.

Processed cereals: Buckwheats, Grapenuts, Shredded Wheat, Puffed Rice, Cheerios, Cornflakes, Rolled Oats. (Choose three or four from each group if you cannot get them all.)

## Words To Know

Energy

## Notes To Myself



# ACTIVITY

1. Ask the children to look at the grains in the bowls. After a few minutes, ask them to describe each kind. What color is wheat (corn, oats, etc.)? How big are the cereal grains? Which are big? Small? What does wheat (corn, oats, etc.) feel like? Would you want to eat them? Do you sometimes eat them? Do you know what kind of grain each one is? (Help them to identify each one.) In what form do you eat this grain? (Wait for someone to suggest breakfast cereal, then place breakfast cereal boxes on the table letting the children match each cereal with the grain it is made from.) Most cereal boxes have the grain illustrated. The World Book Encyclopedia has pictures of grains.

2. Develop the lesson by asking: Do you eat cereal in the morning? Why do you eat it? (Gives energy.) What other foods give energy? (Let them name several different foods.) When you eat food, do you think about how your body changes it into energy? What do teeth do to food? (Break up the food into smaller pieces.) Where in our bodies do changes take place? (Mouth, stomach.) Show me where your stomach is. What happens to food in there? (That's where the food gets changed to chemicals that go to the cells all over your body, where it's changed into energy.)

3. Then say: Find your heart, and feel it beat. You will need to remain very quiet. When you feel it beat, stand up. Conclude this part when most of the children are standing. Then say: Let's do some jumping jacks together. Do at least ten. Now sit down and find your heart again and feel it beat. Is it beating slower or faster than before? Did you use more food energy when you were jumping? When you use up most of the food energy your body has stored, what do you think happens? (You feel hungry, and you know it's time to eat again.)

4. Pass out newsprint folded in half, crayons, and pencils. Say: Think about your favorite food. On the left side of the paper, draw a picture of yourself eating your favorite food. On the right side of the paper, draw something you can do with the energy from the food. (Run, jump, etc.) If you can, write a sentence about your pictures. (Use the pictures for a bulletin board or language experience chart, or let the children take them home.)

ENERGY IS ALL AROUND

## Curriculum Topic

Energy Forms
The School

## Grade Level(s)

K-1

## Site

Various places within school building

## Skills

Observation, locating and obtaining information

## Energy Topic

Energy Sources
Energy Uses

## Credit

Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, 1977.

## Objective

Students should be able to:

1. Identify three forms of energy.
2. Explain some of the ways energy is used in the school.

## To The Teacher

Gas furnaces and gas ovens use chemical energy. When fuel is burned, most of its energy is given off as heat.

Classroom lights use electrical energy. In incandescent lights, the filament or wire is made hot enough so it will radiate light as well as heat. Flourescent lights give off more energy as light and less as heat.

The telephone system uses electrical energy to give motion to the clapper that strikes the bell which in turn vibrates, producing sound. Sound is one of the examples of motion as a form of energy.

The refrigerator and air conditioner use electrical energy to extract heat from inside the container and discharge it to the outside.

In previous lessons, children learned that heat and motion are forms of energy.

## Before You Begin

You will need drawing paper pencils, and crayons for each student.

In advance of the day's lesson, arrange with the school custodian for a suitable time to visit the boiler room. Plan with the cafeteria staff for an appropriate time to visit the kitchen. You may wish to arrange for a class visit to the school office and school library.

Prepare your children for any of the trips you take around the building. These places may be visited in any order. Be sure the children know they are to look for places where energy is being used. What you see will depend on your particular school building. Have them watch for things that produce motion, heat, or light energy. You may choose to use one or more of the following trips:

Boiler Room -- Children should notice the furnace and the hot water heater, water pumps and air blowers. Energy forms are heat, motion, and light.

Cafeteria -- Children should notice the ovens (heat), refrigerators (heat/cool), dishwasher (heat, motion), mixer (heat, motion), slicer (heat, motion), etc.

Library -- movie projector (heat, motion, light).

Office -- electric typewriter (motion), bell system (sound, motion), florescent lamp (light).

## Words To Know

Energy

## Notes To Myself

# ACTIVITY

1. Conduct building tour.

2. Following the trip, ask the children to choose one thing they saw on the tour and to draw it. They might print at the bottom of the picture the form of energy being produced -- heat, light, or motion.

3. Make up some riddles to recall some of the energy users seen on the tours:

   a. In the office we saw something that was on a desk, moved and used electricity. It was a ______________. (Typewriter.)

   b. In the library we saw something that used a light, had two spools that moved and used electricity. It was a ______________. (Projector.)

   c. In one room we saw something that uses oil and gives off heat. It was a ______________. (Furnace.)

   d. We saw something that gives off heat energy, has a light in it and uses electrical energy. It was a ______________. (Oven.)

   e. We saw something that has a round base, that twirls around and uses electricity. It was a ______________. (Floor polisher.)

   f. We saw something that uses electricity and makes a noise. It was a ______________. (Bell.)

   g. We saw something that was rectangular, uses electricity and makes things cold. It was a ______________. (Freezer.)

4. Review the facts concerning the forms of energy by playing a memory game. Tell the children: To play this game you must repeat what I say and then add something of your own.

I went on an energy tour. I saw ______________.

First student..................a potato frying.
Second student.................a furnace heating.
Third student..................a boy jumping.
Fourth student.................etc.

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# WIND IS A SOURCE OF ENERGY

## Curriculum Topic

Energy Forms - The Wind
Weather

## Energy Topic

Energy Sources
Energy Uses

## Grade Level(s)

K-2

## Site

Classroom

## Skills

Observing, constructing a model

**Credit** Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, 1977.

## Objective

Students should be able to:

1. Identify wind as a source of energy.
2. Construct a windmill.
3. Observe the relationship between the force of the wind and the speed of the pinwheel.

## To The Teacher

Until the turn of the century, wind was put to good use in this country. It was used mainly for sailing ships and for pumping water and generating electricity on our prairies. However, the wind gave way to the more reliable steam power, and the wind-driven generators gave way to electricity from the big power plants.

Wind has one major drawback, and that is its variability. If technology can harness wind to an electric system that will not peak and decline, then wind can become a source of power of the future.

This lesson stresses the skill of observation. It also stresses the fact that student opinion must necessarily be tentative and partial. The actual conditions of the wind are learned by further experience.

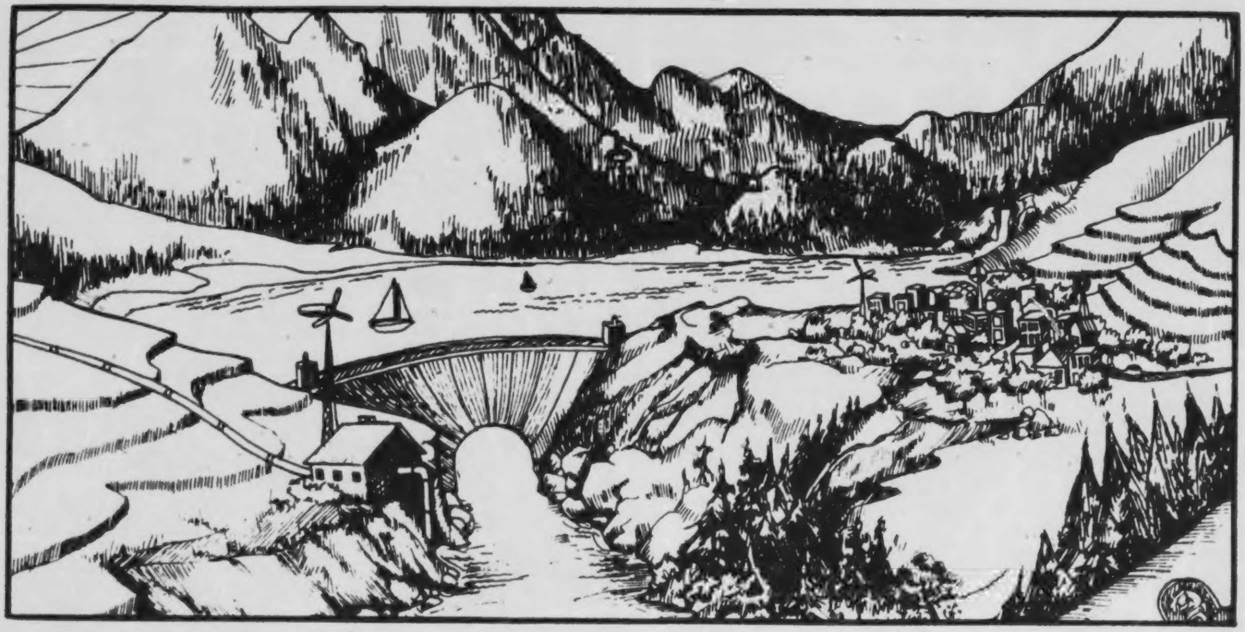
## Before You Begin

You will need the following materials:

Large paper bag
Cardboard tube
Rubber band
Paper dolls (that will stand up)
Windmill pattern for each student
Paper clips
Milk cartons for each student
Construction paper

## Words To Know

windmill



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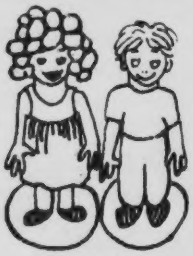
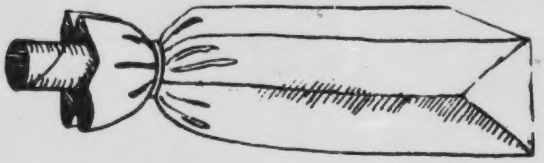
# ACTIVITY

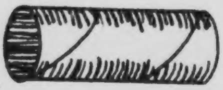
1. Announce that today's lesson will be about an energy source that starts with the letter W. Ask students to try to guess what this energy source is while they watch something. You will need the following pictured items:



Paper dolls



Paper bag



Cardboard tube

2. Attach the cardboard tube to the open end of the paper bag with rubber bands. Place the bag on the table. Set up the paper dolls at a distance of 4 cm (2 inches) from the end of the tube. Push hard on the bag. Ask: What happened? What was in the bag that made the dolls fall down? (Air) What happened when I pushed hard on the bag? (It made the air move out fast.) What do we call moving air? (Wind) Were you ever - like these paper dolls - knocked down by the wind? (Allow the children to share windy day experiences.) What does this show about wind? (It has energy.) How do we use the energy in the wind? (If children mention windmills, ask where they have seen one and what kind of work the windmill was doing - pumping water or grinding corn, etc. If the children mention sailboats, ask if they have sailed in one and if it went fast or slow.)

3. Make some windmills. Give each child a dittoed copy of the pinwheel pattern. Cut it out and fasten it together with an unbent paper clip. Cover the milk carton with construction paper. Color doors and windows on this mill house. Fasten the wheel to the top front of the house by inserting one end of the paper clip into the top of the roof.

4. Have the child represent the wind and blow the pinwheel. Explain that in a real windmill the turning wheel would turn some machinery to do some work - perhaps draw up water from a well or grind some corn.

5. Ask: Does your pinwheel move if you don't blow on it? (Air currents in the room may cause it to move.) Blow gently on you pinwheel. Does it move slowly or fast? Blow a little harder. Does your pinwheel move slower or faster? Who can make a rule about the pinwheel? (The harder you blow on it, the faster it turns.) What are you using to turn the pinwheel? (Wind energy.)

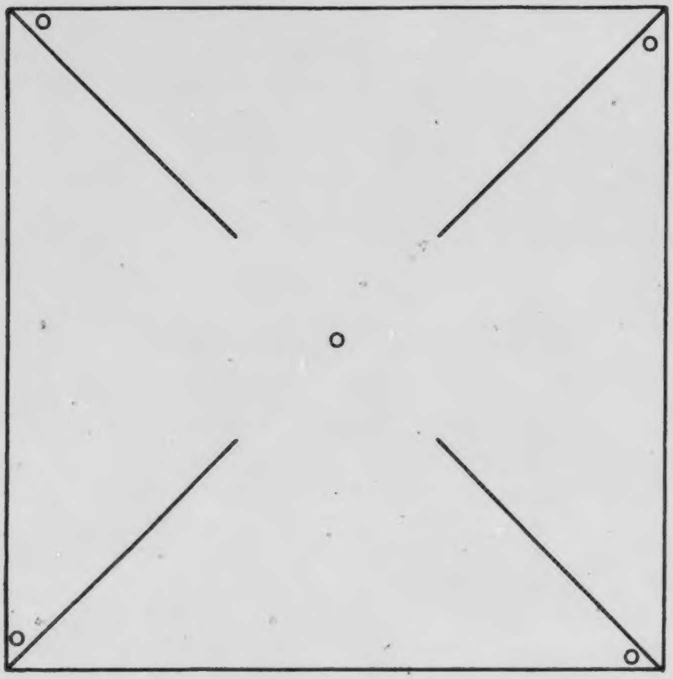
## Related Activities

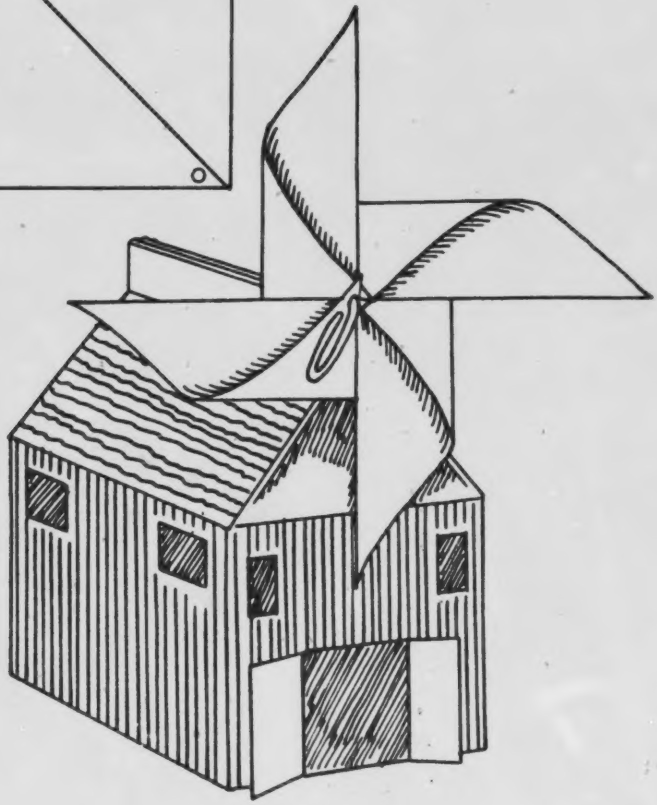
Place some drops of poster paint on wet finger paint paper. Blow through a straw to move paint and create a design. Ask students what causes the paint to move?

Make kites to fly on a windy day.

## Notes To Myself

# STUDENT PAGE





## WATER IS A SOURCE OF ENERGY

### Curriculum Topic

Sources of Energy - Moving Water
U.S. History: Life in the Past

### Energy Topic

Energy Sources
Energy Uses

### Grade Level(s)

K-2

### Site

Classroom

### Skills

Observing, concluding, constructing models

**Credit** Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, 1977.

### Objective

Students should be able to:

1. Identify moving water as a source of energy.
2. Construct a waterwheel and observe that water can make it move.

### To The Teacher

One of the oldest sources of energy used by people has been moving water. People have used water to transport themselves and their goods. They used waterfalls to run the machinery which ground grain and sharpened tools. Today river water collects in natural waterfalls or man-made dams or lakes, where giant waterwheels or turbines run generators which produce electricity.

Using the historical approach, this lesson explains some of the purposes of waterwheels of the past and the growth of hydroelectric plants.

### Before You Begin

You will need pictures of dams, pictures of a mill with a waterwheel, piece of tagboard, and a pin.

### Words To Know

Hydroelectric

# ACTIVITY

1. Look at (or have the children bring in) a picture of a mill with a waterwheel. (One good source for pictures is Windmills and Watermills, by John Reynolds (Praeger, New York, 1970). Ask: What makes this wheel turn? (Moving water.) Explain that the farmers used to bring their corn and grain to the miller who would grind them up in his mill. His mill was always built near a river so he could use moving water to turn the grinding wheels. Make a waterwheel and see how it works.

2. Trace a waterwheel on a piece of tagboard. Cut on solid lines and fold in the dashed lines. Fold in the same direction around the wheel. Put a pin through the dot. Holding the pin, put the waterwheel under a slow-running faucet and watch the water make the wheel turn. (Dried out after use, this wheel will last through two or three demonstrations. A more permanent wheel can be made using the end of a tin can.)

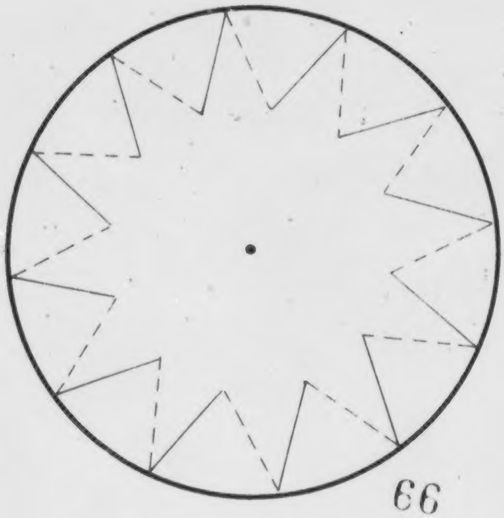
3. Look at (or have the children bring in) a picture of a hydroelectric power plant. Show the picture of the hydroelectric plant and dam. Ask:

> What is moving in the picture? (Water and wheel.)
> Where is the water going? (Over the edge of the embankment.)
> Who has seen a waterfall? (Ask them to describe how it looked, the noise it made, etc.)

Explain that a dam is a man-made waterfall - that it is built to use water as a source of energy. Tell them there is usually a large building next to the dam where electricity is produced from the moving water.

## Related Activities

Field Trip - Visit a hydroelectric dam or an old gristmill if one is within your geographic region.



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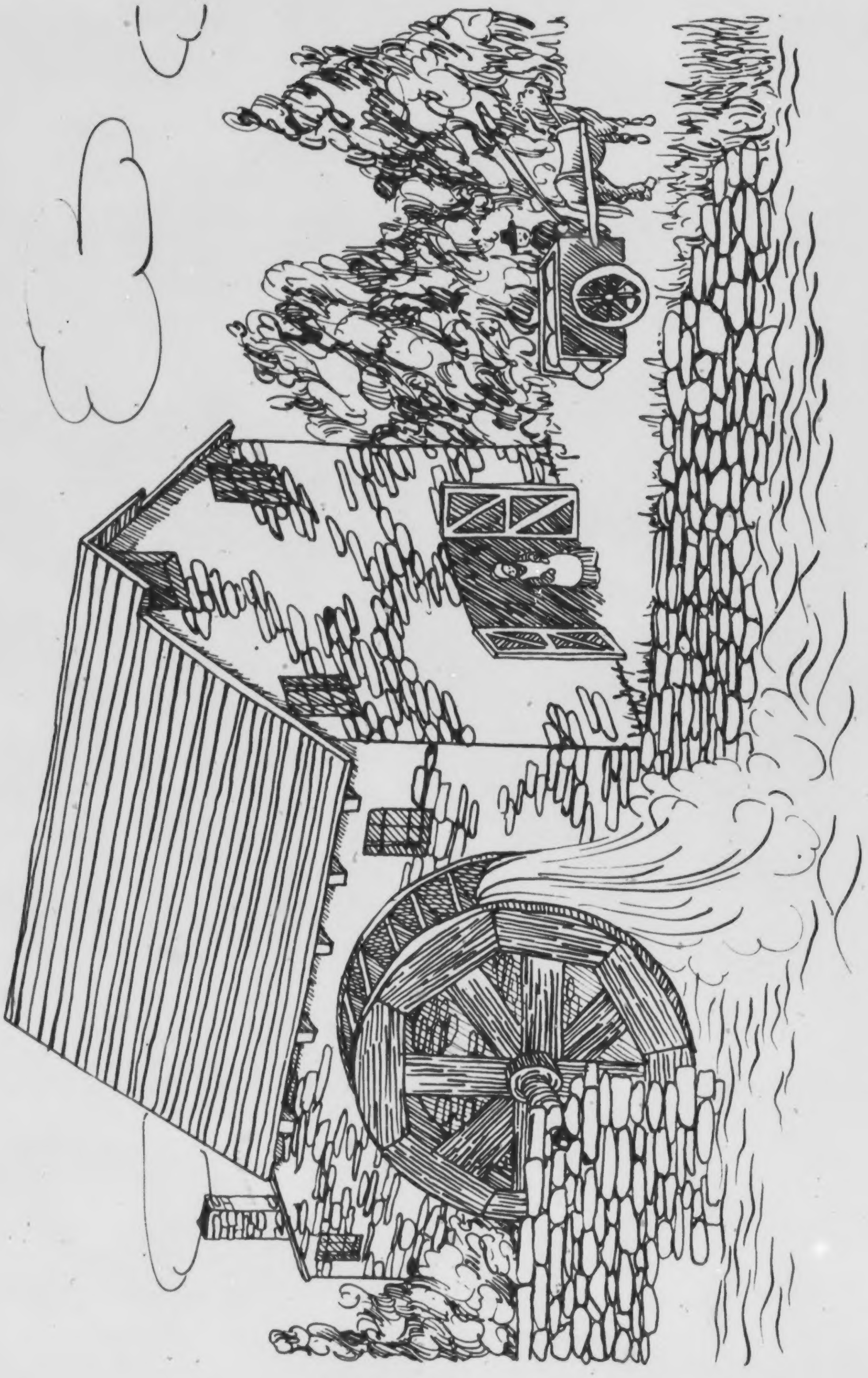

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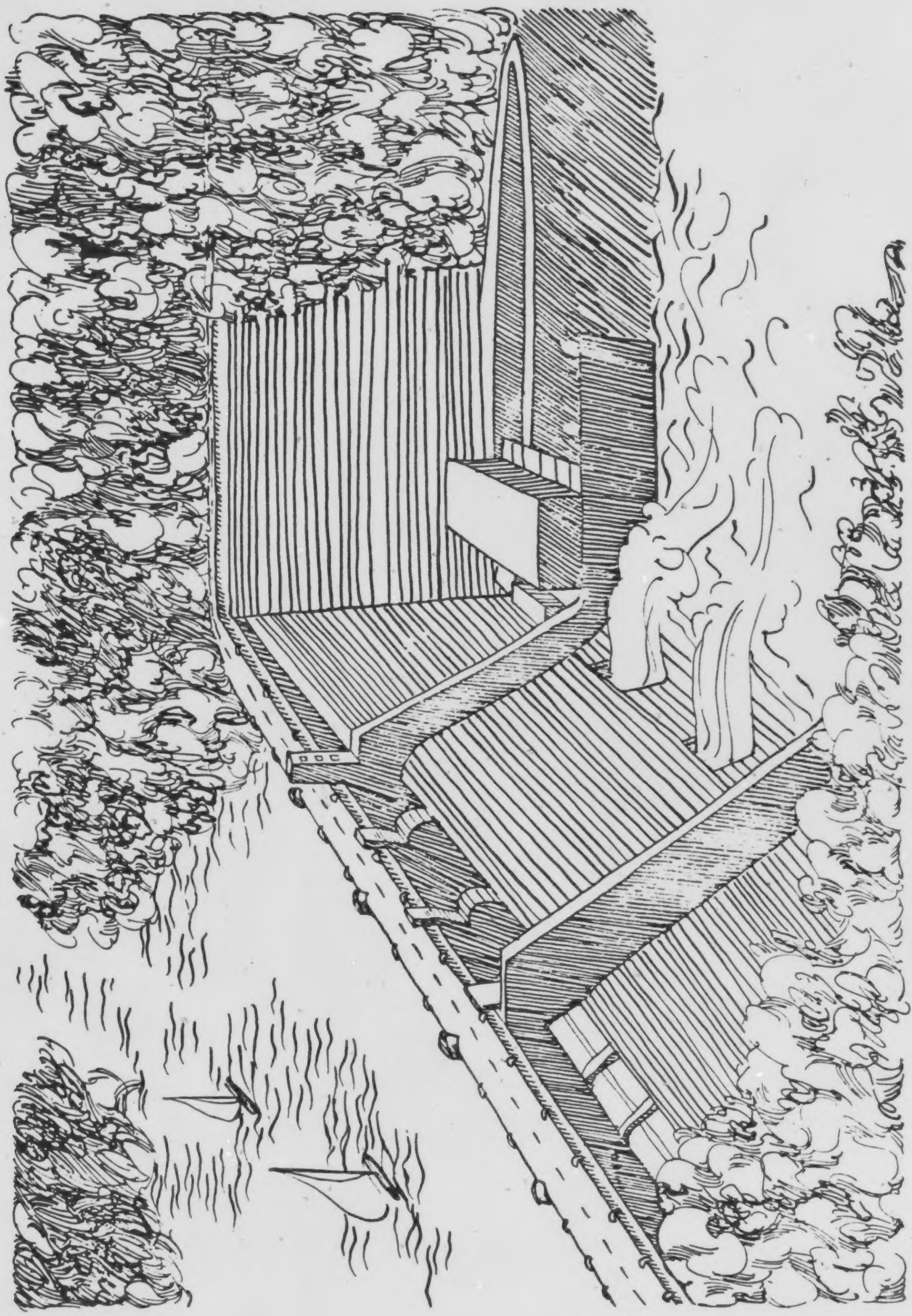


THE STORY OF OLIVIA OIL

## Curriculum Topic

Transportation
Fossil Fuels

## Energy Topic

Energy Sources
Energy Uses

## Grade Level(s)

3-4

## Site

Classroom

## Skills

Reading, organizing information

## Credit

Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, 1977.

## Objective

Students should be able to:

1. Identify oil as the raw material for transporation fuels.
2. Sequence the steps from oil well to oil products.
3. Name at least two kinds of fuels made from crude oil.

## To The Teacher

The first United States oil well, a well only 69.5 feet deep, was drilled in August 1859 outside Titusville, Pennsylvania. The United States was an oil exporting nation until the 1950's, but has increasingly become an importing one. In 1976 our crude oil imports made up 41 percent of the total petroleum supply. The invention of the gasoline engines, in about 1880, produced the present dominant market for oil. Gasoline and fuel oil account for almost 90 percent of the total petroleum market.

## Before You Begin

Duplicate copies of "The Story of Olivia Oil"
Duplicate pictures that go along with The Story of Olivia Oil" and cut out individual pictures for each student.

## Words To Know

Fuel

# ACTIVITY

1. Distribute copies of The Story of Olivia Oil and ask different students to read each section orally while others read quietly.

2. After the story has been read aloud, discuss the story by asking:

   a. Where is oil found? (Ground.) Do you think it is found everywhere or in special places? (Special places.)

   b. What kind of transportation is used to move oil over water? (Oil tankers.) How is it moved over land? (Pipe lines.) Has anyone heard anything about the Alaskan Pipeline? (Pipeline is completed. It has been shut down several times since it opened.)

   c. What is oil called when it is first found? (Crude oil.) What is it called after it has been to the refinery? (Gasoline, heating oil, diesel fuel, kerosene.)

   d. Do you think we use a lot of oil in our daily lives? Give reasons.

   e. What does fuel mean? (Use dictionary if necessary. Fuel may be defined as something that is burned to make heat or power.)

3. Write the following sentences on the board and ask the students to copy them in the correct order. Students may refer to The Story of Olivia Oil if they need to do so.

   1. I'm sent by pipes or tankers to the refinery.
   2. I become gasoline, diesel fuel or oil.
   3. I begin as crude oil in the ground.
   4. At the refinery; I'm changed into other things.

4. Distribute picture cut-outs that go along with "The Story of Olivia Oil" and ask students to paste each picture in the correct blank space on the story page.

COPYRIGHTED CARTOON DELETED

# The Story of Olivia Oil

Hi! I'm Olivia Oil. People tell me I'm very important because I help people. To learn how I can be useful, read my story.

1. To find me you must look in the ground. First dig a deep hole. Then use a pump to pull me from the ground. I am called "crude oil" now.

oil field

2. Next I go on a trip. I am put in a pipeline (like the Alaskan Pipeline).

pipeline

OR

3. I am put in a big ship called an oil tanker and sent to a refinery.

tanker

4. A refinery is a place where I am changed into ....

refinery

5. ...gasoline for use in cars, busses and taxis...

gas pump

OR

6. ...diesel fuel for use in trucks, cars, and ships

diesel pump

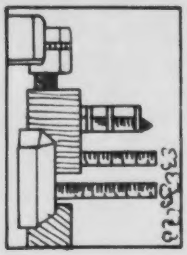
7. ...oil for heating homes

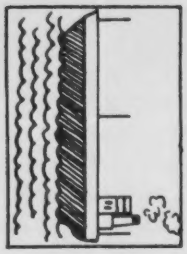
furnace

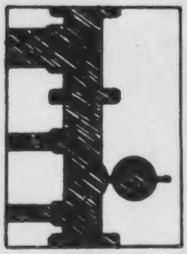
8. From the refinery, I travel by truck to wherever I am needed.

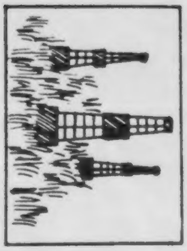
**STUDENT PAGE**

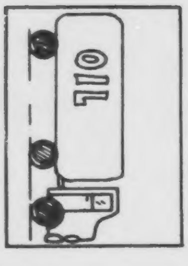
# STUDENT PAGE

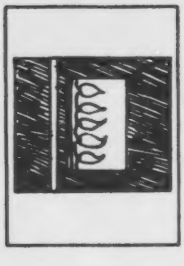


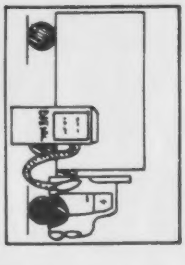


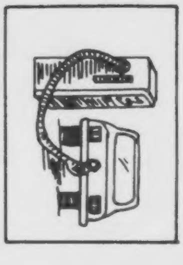












73

# Insulation Works

### Curriculum Topic

Heat

### Energy Topic

Energy Sources
Energy Conservation

### Grade Level(s)

3-5

### Site

Classroom

### Skills

Constructing and testing hypotheses
Graphing data
Measuring
Using information for a purpose

**Credit** "Current Science," Xerox Corporation, Middletown, Ohio, Vol. 63, No. 2, Sept. 21, 1977 Adapted by Cyndi Walsh in EARTHWATCH, Vol. I, EEC, Area Cooperative Educational Services, New Haven, CT, 1978.

## Objective

The student will be able to demonstrate an understanding of the properties of insulation.

## To The Teacher

"Insulation is being produced from a variety of materials: vermiculite, fiberglass, rock wool and, significantly, old newsprint - referred to as cellulose insulation. The manufacturing process for cellulose insulation, although it requires heavy equipment, is relatively simple. The newsprint is finely shredded and then mixed with fire-retardant and vermin-resistant chemicals - boric acid, borax and aluminum sulfate. The finished product looks like thick gray lint, and is installed by a blower. Cellulose insulation frequently is cheaper than insulation made from other materials, and dollar for dollar and inch for inch, it has a higher "R factor" (a term used to measure resistance to heat flow) than other types of insulation." ("Current Science")

The following activities demonstrate the properties of insulation.

In the first experiment, students will discover that an insulated box will hold heat in a refrigerated environment. This can be compared to the insulation properties of a house or a goose down jacket on a cold winter's day. A graphing exercise concludes this activity and will provide a working knowledge of the metric system as milliliter and celsius units are used.

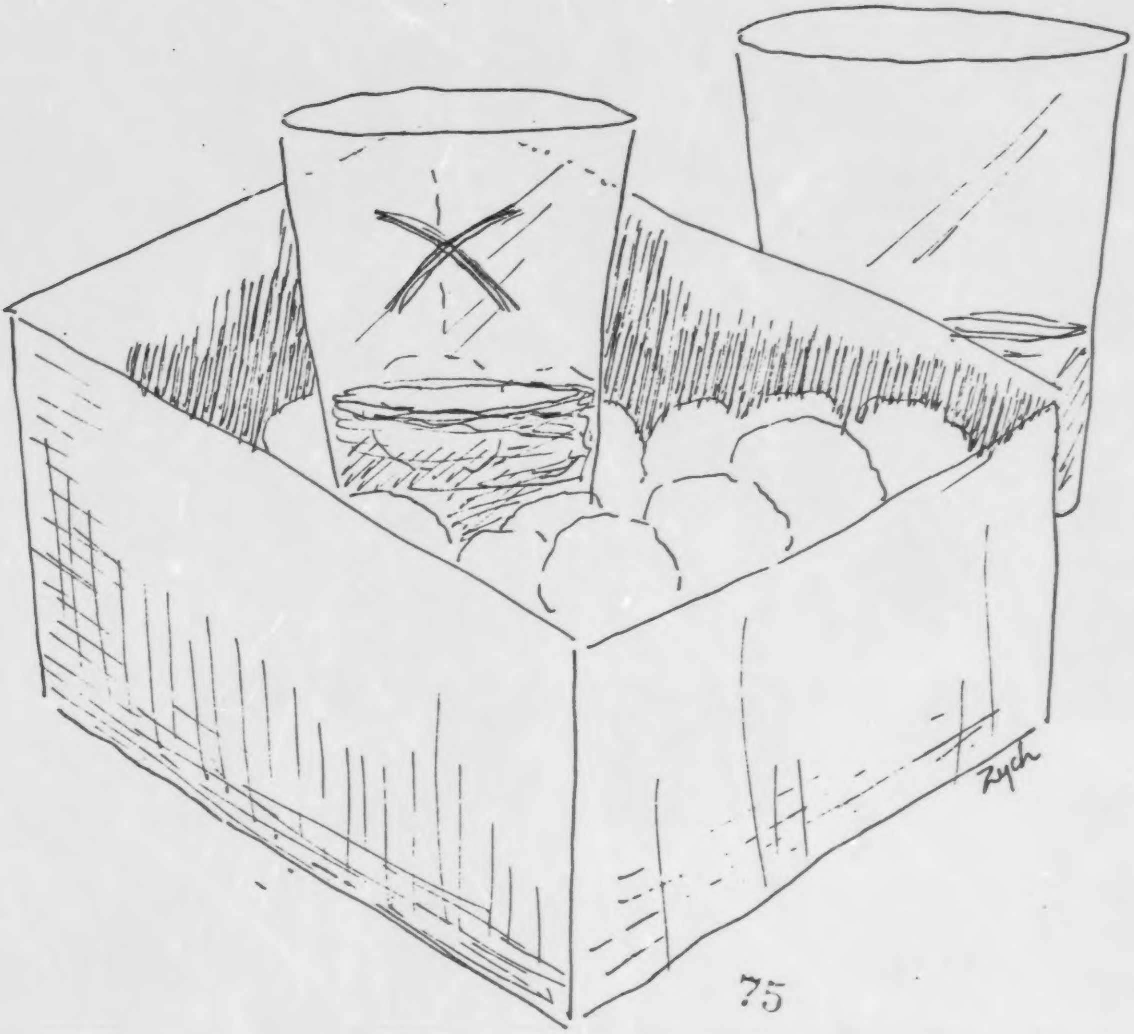
The second and third experiments will explore the insulation properties of the home refrigerator. (Before students conduct this experiment, obtain parental permission.) Students will discover that a cool temperature can be maintained in an unplugged refrigerator. They will also learn that when the door is opened every 5 minutes, the refrigerator does not maintain cooled temperatures. The results should encourage proper energy conservation in the home.

## Before You Begin

MATERIALS: 2 celsius thermometers, cardboard shoe box with lid, cotton balls or other insulation material, 2 identical glass containers, graduated metric beaker or cup.

## Words To Know

insulation, milliliter, celsius, thermometer



# ACTIVITY

Depending on class size and availability of equipment, assign the following three experiments:

EXPERIMENT 1:

1. Make an "insulation box" by layering cotton balls inside the bottom of a small cardboard box.

2. Obtain two identical glass containers. Mark one of the containers with an X for identification.

3. Fill both containers with 25 ml of water at room temperature (18 degrees Celsius).

4. Record the temperature of each. Leave the thermometer in the containers.

5. Place the X container of water in the insulation box. Fill the surrounding space with cotton balls. Replace the lid.

6. Place both glass containers in the refrigerator.

7. Make an educated guess (hypothesis) about the temperature of each container in a half hour.

8. Record the temperatures every 5 minutes for half an hour.

9. Show the resulting temperatures on a graph or chart. What is your conclusion? Did your results support your hypothesis?

10. Discuss with the class how you would change or improve this experiment?

EXPERIMENT 2:

1. Record the room temperature reading in Celsius and Farenheit.

2. Then put the thermometer in the refrigerator for 15 minutes and record the temperature.

3. Put the thermometer in the refrigerator and unplug it. Leave the door closed for another 15 minutes with the thermometer still inside. Make a hypothesis about the result of this experiment.

4. After 15 minutes, record the temperature. What are your conclusions? What happened? Why? Do your conclusions support your hypothesis?

EXPERIMENT 3:

1. Fifteen minutes after the refrigerator is plugged in, do all of the above steps in experiment 2 with one variation. Open and close the refrigerator every 5 minutes, holding the door open for 30 seconds at a time.

2. Check the temperature every fifteen minutes. Do you think the temperature will remain the same? Make an hypothesis. Do your findings support your hypothesis?

## Related Activities

1. Make insulated milk carton houses from different materials. Put ice cubes in the carton and then time the life of the ice cubes on a hot day.

2. Research refrigerators. Use consumer reports to find the most energy-conserving features.

## Credit

"Current Science," Xerox Corporation, Middletown, Ohio, Vol. 63, No. 2, September 21, 1977
Drawing: Cecelia Zych

## Resources

Energy-Environment Mini Unit Guide, NSTA, Washington, D.C., 1975

## Notes To Myself

# Build a Kite

## Curriculum Topic

Meteorology
Energy Forms

## Energy Topic

Energy Sources

## Grade Level(s)

4-6

**Site** Classroom, large open areas: ball fields, beaches, or playgrounds

## Skills

Collecting, compiling, graphing, and measuring data
Constructing a model

**Credit** Stephanson, Lee, Energy Manual for Parks, National Recreation & Park Assoc., Arlington, VA 1976. Adapted by Paul Sanderson, in EARTHWATCH, Vol. II, Environmental Education Center, ACES, New Haven, 1978

## Objective

The student will be able to:

1. construct a working kite and experiment with the amount of wind energy it can utilize,

2. plot a graph showing pounds of pull in relationship to wind speed or kite size.

## To The Teacher

Our survival will depend upon our rational ability to make maximim use of our limited energy resources, and to exploit alternative sources with minimum impact to our environment.

Building kites and experimenting with them is a good way for students to gain first hand experience with an alternate form of energy, wind energy. Kites are inexpensive and easy to build. The tradition is that kites were invented by Archytas of Tarentum four centuries prior to the Christian era, but they have been in use among barbarous tribes like the Maoris of New Zealand and Asiatic peoples from time immemorial. Their purposes have included ceremonial, mystical, recreational, scientific, and military. Today, they serve chiefly as a fascinating toy, one that can introduce students to an energy source for the future, wind power.

"Wind is a solar energy form which results from the uneven heating of the earth's atmosphere by the sun. Wind is even more variable than sunlight, changing with location, season, and the weather of the moment. Wind seldom blows at a constant speed but rather swells and ebbs in an irregular fashion. Its flow is also affected by landscape.

"Wind can also provide both mechanical and electrical power and has a long history in the U.S., having been used extensively for water pumping and other mechanical chores by the settlers as they developed the western states. But by the middle of the twentieth century most wind machine companies had gone out of business and fossil fuels had taken over their former chores. Now, increasing costs and shortages of fossil fuels have given the windpower industry new life. Small, private companies are flourishing again and the federal government has begun to invest millions yearly in windpower research. The government program is focused primarily on large windmills which could supplement electric utility generating capacity.

"Windpower creates very little pollution, although the machines are unsightly. Net energy yields are also uncertain. However, both small- and large-scale wind systems have great potential." (Stephanson)

## Before You Begin

1. Review the enclosed information on kites. It gives you everything you need to know about building the simple kite to be used in this experiment.

2. Materials needed for building kites include: wood for frame (bamboo or dowels are good or your lumber yard will cut pine, spruce, or cedar to your specifications), plus paper, cloth or plastic for the wings. Also, glue or cloth cement, thread, cord, string and paints or marker pens. Masking tape, scissors, sharp knives, rulers, pens, pencils, clothespins, eyelets and grommets are helpful.

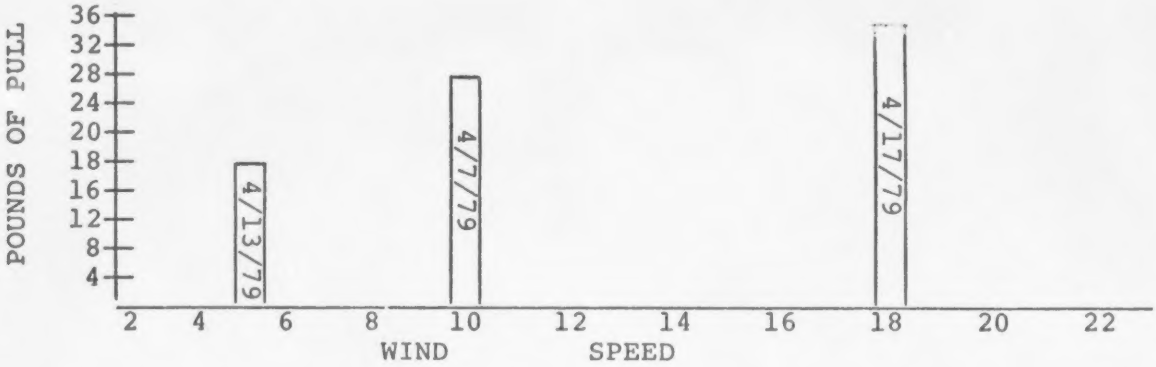
3. Obtain one or more hanging scales, such as the ones used to weigh fish. They should be small enough to be handled easily by your students. The higher the scale range (in pounds), the better. This scale will be attached to the kite's flying string to measure its pull in pounds.

4. Obtain a Beaufort scale in order to estimate wind speed. (One is included below.) An anemometer would be interesting to use, if one is available to you.

"In 1805 Rear Admiral Sir Francis Beaufort devised his classic wind scale for sailors, rating 0 as a dead calm and 12, the top number, as a hurricane. The numbers from 1 to 6, which are germane to kite-flying, can be translated like this:

1 - 1 to 3 mph. Smoke drifts lazily.
2 - 4 to 7 mph. Tree leaves rustle.
3 - 6 to 12 mph. Small flags fly, leaves dance.
4 - 13 to 18 mph. Trees toss, dust flies, paper skitters.
5 - 19 to 24 mph. Trees sway, kite strings break.
6 - 25 to 31 mph. Flying is risky." (Brummitt)

5. Devise a sample graph to demonstrate how the students will graph their data. For example:



6. This activity might work better in the spring. Wind is readily available then.

7. Be careful flying kites near power lines, buildings, roads, or before a storm.

## Words To Know

Beaufort scale, "pull", graph, wind power alternative energy source

# ACTIVITY

1. Build the two-sticker kite per instructions enclosed. Make sure you allow enough space for construction, especially if each student will be building a kite. Teams may work better in larger class situations. If you wish to learn more about kites, or investigate other designs, read Kites, by Wyatt Brummitt, Golden Press, 1971. It is an inexpensive paperback that everyone can use.

2. Fly the kites. As you do, have the students record estimates of wind speed, and the pull in pounds on the flying line using your scale.

3. Fly the kites several times, under varying wind speeds. Keep records of your experiments.

4. Using the data, plot a graph that shows the relationship between wind speed and "pull".

5. Then discuss:

   a) the relationship of wind speed to pull

   b) how your kite caught wind energy and converted it into "pull" energy

   c) what uses this "pull" energy might have (to pull carts, boats, lift objects, etc.)

   d) other ways to use wind energy (to run machines or wind mills, to generate electricity, to propel sailboats, parachutes).

   e) the environmental impact of wind power

## Related Activities

1. Study how wind power is/was used in America as a source of energy.

2. Discuss some of the limitations of the wind as an alternative source of energy.

3. Visit a windmill, if possible.

## Resources

Brummitt, Wyatt, Kites, Golden Press, N.Y., 1971

## Credit

Stephanson, Lee, Energy Manual for Parks, National Recreation and Park Assoc., Arlington, VA, 1976

Drawing: Ann-Marie Fleming

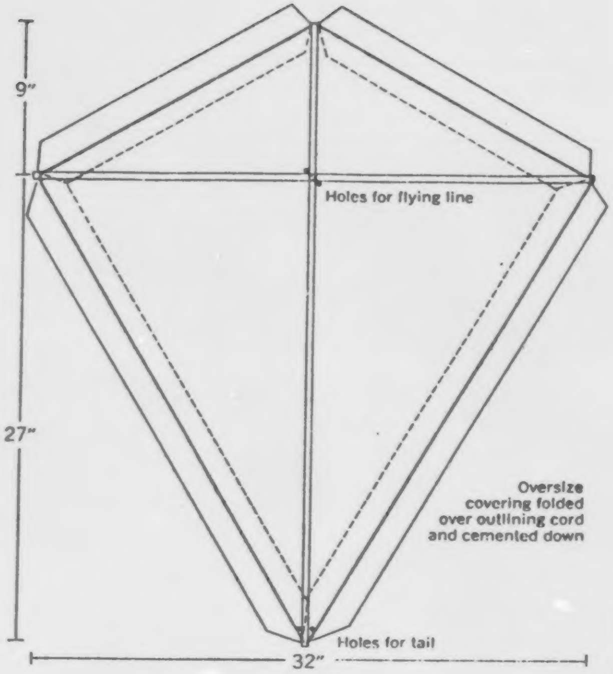
## THE CLASSIC TWO-STICKER

The two-sticker is the most conventional, the most "kite shaped" kite. Like all flat kites, it requires a tail, and also like most such kites, it flies at a fairly low angle, with maximum drag and minimum lift.

As the drawing shows, you need two sticks: a mast and a somewhat shorter spar. The spar should cross the mast about a quarter of the way down. Center it there and fasten it at a right angle, using either a twisted rubber band or a few windings of thread-and-glue. Outline the kite with string tied to the four stick ends. Do not pull the string so tight that it warps the frame.

Spread out the covering—newspaper, shelving paper, butcher's paper, or any similar paper will do—and position the outlined frame on it. A couple of bits of tape will hold paper and frame together while you draw the outline of the kite on the paper. Make the outline an inch or two oversize so that, when the covering is cut to shape, there will be a margin to fold over and paste down over the outlining string. Notches must be cut in the covering where it fits around stick ends.

The flying line goes through holes in the face of the kite at the central mast-spar joint. To make the kite shipshape as well as to prevent rips, surround the holes with linen reinforcing rings—the sort used for bracing looseleaf notebook paper. The end of the flying line passes through the hole on one side of the joint and comes back out through the diagonally opposite hole. Tie it securely. Two holes on either side of the mast, just inside the bottom hems, give you a tying hold for the tail.


9"
Holes for flying line
27"
Oversize covering folded over outlining cord and cemented down
Holes for tail
32"

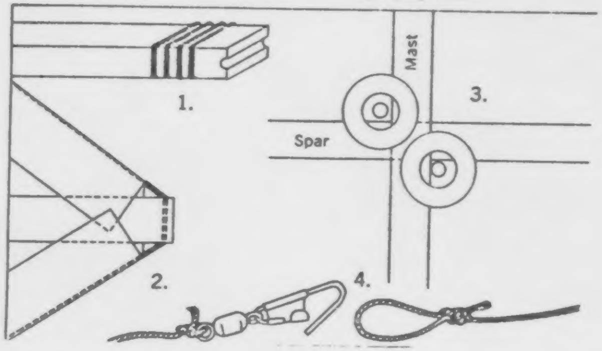
The tail need not be heavy. Its purpose is to resist the kite's naturally skittish tendencies. For a starter, try ten or twelve feet of kite line with crepe paper bows tied into it every foot or so. Flight tests will indicate whether the tail is too short or too long.

Kite tails are not intended to provide balance in terms of weight, which only makes a kite sluggish. Tails add drag, or resistance, allowing the kite to soar freely.

Unless you have a wind of 8 or 10 mph, you will probably need the help of a friend to get this kite airborne. The tail should be stretched out on the ground downwind of the kite so that, from the start, it is effective as a balance. If you have to run with this kite, as will almost certainly be necessary in very light winds, go to it.

Vary the dimensions shown as much as you please; nothing about this kite is very critical. Resist temptation to make it really big. The results are unrewarding. Flat kites may be primitive, but they are never dull. And they can be of almost any shape, size, or material.

**THE TWO-STICKER** In making your kite, you should (1) notch the spars to hold the outlining cord and bind the notched ends to prevent their splitting. The covering (2) should be cut away at the corners, allowing at least an inch of fold-over for cementing. The line or bridle (3) is connected at the central mast-spar joint, with gummed reinforcement circlets used to protect the covering around the holes. The flying line (4) can be connected directly or by means of a one-legged bridle. The connection is made easy with a loop and a fishing swivel. A swivel belongs on the end of every flying line.



# Reducing Friction Saves Energy

## Curriculum Topic
Forces and Work

## Energy Topic
Energy Sources
Energy Conservation

## Grade Level(s)
4-6

## Site
Classroom

## Skills
Experimenting, concluding

**Credit** Paul Sanderson, in EARTHWATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT 1978.

## Objective

The student will be able to:

1. recognize some substances or items which help reduce friction,
2. relate that friction causes heat,
3. recognize that friction is sometimes useful and sometimes wasteful.

## To The Teacher

Friction is the rubbing of two surfaces together or the resistance to relative motion between two surfaces in contact, resulting in heat energy. It has obvious benefits. Without it, we would not be able to move, contact or grip another substance. Think about walking, or turning a doorknob without it. Friction can be quite comical and frustrating. But in our mechanical, technological society, friction is often an enemy. It wears down machine parts and depletes us of useful energy. In a car it wears tires, decreases gas mileage, and eventually destroys even steel lubricated parts, such as pistons, cylinders and valves.

There are substances and items that help reduce friction and conserve energy (e.g. oil and grease, bearings, rollers and wheels). This activity will explore how some of these help reduce friction.

# ACTIVITY

1.a. Introduce the activity by having the students rub their hands together vigorously. Ask them what they felt. (heat) Explain that two surfaces rubbing against each other cause friction and friction causes heat.

b. Now have the students put a dab of hand lotion in the palm of one hand,and rub again. Did they feel as much heat? Why not? Explain that some substances reduce friction and reduce its heat.

2.a. Pass out the small wooden blocks. Wrap a sheet of sandpaper around the block and thumbtack it in place. Have the students rub two such blocks together. Does it cause friction? Heat?

b. Ask students what would help reduce this friction? Pass out the heavy grease and put a dab between the sandpaper blocks. Rub them again. What took place? Why?

3.a. Ask the students to attempt to grasp the point of the screwdriver between thumb and forefinger. Let the handle of the screwdriver hang freely. They should be able to do this.

b. Now dip the point of the screwdriver in the heavy motor oil and repeat the experiment. Can they grip the screwdriver now? What has happened?

4.a. Ask students to place two smooth-sided coffee can lids together. Do they slide very easily when pressed together?

b. Now place a dozen or so marbles between the lids (lid sides will hold the marbles on the lids). Repeat the experiment. Do the lids move more easily? Why? Explain that the marbles act as ball bearings helping the two surfaces move with less friction.

5.a. Fill the "sturdy" box with about 100 pounds of weight (less weight will also work). Ask several hearty students to slide it across the room. Have them describe their work. What made it hard? (weight and friction)

b. Using the pipes or dowels as rollers, move the box. Lift one side of the box and slide a roller under. Push forward and add another roller. Push forward. Try to keep at least 2 rollers under the box at all times. When one roller comes out from behind the box, move it to the front again and push. Be careful of fingers and toes. Did the rollers make the work easier? Why? (reduced friction, acts like a bearing)

6. Discussion Question:

   a. What causes friction?

   b. How did your hands feel? (hot)

   c. What helped reduce the friction? Heat? (hand lotion)

   d. How does oil or grease reduce friction? (makes things slippier) How do they help us conserve energy? (reducing the energy needed to do work)

   e. Where else do we use oil or grease? (cars, engines, hinges, wheels, machines, etc.) Does it help reduce energy? Which uses more energy, a well lubricated car, or one that needs grease? Which would use more gasoline? Get better mileage?

f. How do marbles reduce friction? (they act as bearings) Do they help conserve energy? How? (by reducing the energy needed to do work, by decreasing friction)

g. Give examples of articles with ball bearings. (bike wheels, skates, skateboards, car wheels)

h. Do rollers reduce friction? (yes, they act like bearings) Did they help conserve *your* energy in the experiment? How?

i. When is friction a good thing to have? (when stopping a car, lighting a match, running, lifting items, holding things)

## Related Activities

1. Study how simple machines save energy and reduce friction.

2. Experiment with wheels or toy cars using oil or no oil to reduce friction.

## Resources

*Science 5*, The Silver Burdett Science Program, General Learning Company, 1968, pp. 194-195.

## Before You Begin

Materials: hand cream (with plunger-top dispenser if possible), sandpaper, small wood blocks, thumbtacks, heavy grease (such as wheel bearing grease from auto supply store), heavy motor oil like STP, screwdrivers with beveled tips, marbles, coffee can lids (the plastic ones with lips), four 3 foot lengths of steel pipe of equal diameter or similarly shaped objects such as dowels of wood (old broom handles will also work), a sturdy box capable of holding 100 pounds of weight, 100 pounds of weight (such as rocks, sand, bar bell weights)

## Words To Know

friction, ball bearing, roller, reduce

# Wind Meter

## Curriculum Topic

Meteorology

## Energy Topic

Energy Sources
Energy Uses

## Grade Level(s)

4-6

## Site

Classroom or family car

## Skills

Constructing, measuring, implementing, evaluating information

**Credit** "Stormy Weather", Individualized Science Instructional System, Ginn & Co., 1976 Adapted by Carla McGeeney, in EARTHWATCH, Vol. I, EEC, Area Cooperative Educational Services, New Haven, CT, 1978. Drawings: Cecelia Zych

## Objective

The students will be able to:

1. describe steps in the construction of an anemometer,
2. be able to roughly calculate the speed of the wind,
3. list some ways and uses for harnessing wind energy,
4. locate the windiest area of their school (windward side).

## To The Teacher

Ecosystems include not only the living (biotic) system, but the non-living or abiotic environment, such as weather as well.

The amount of rain and wind in an area determines what kind of vegetation can exist there. It also determines the wind-chill factor which we interpret at a comfort level.

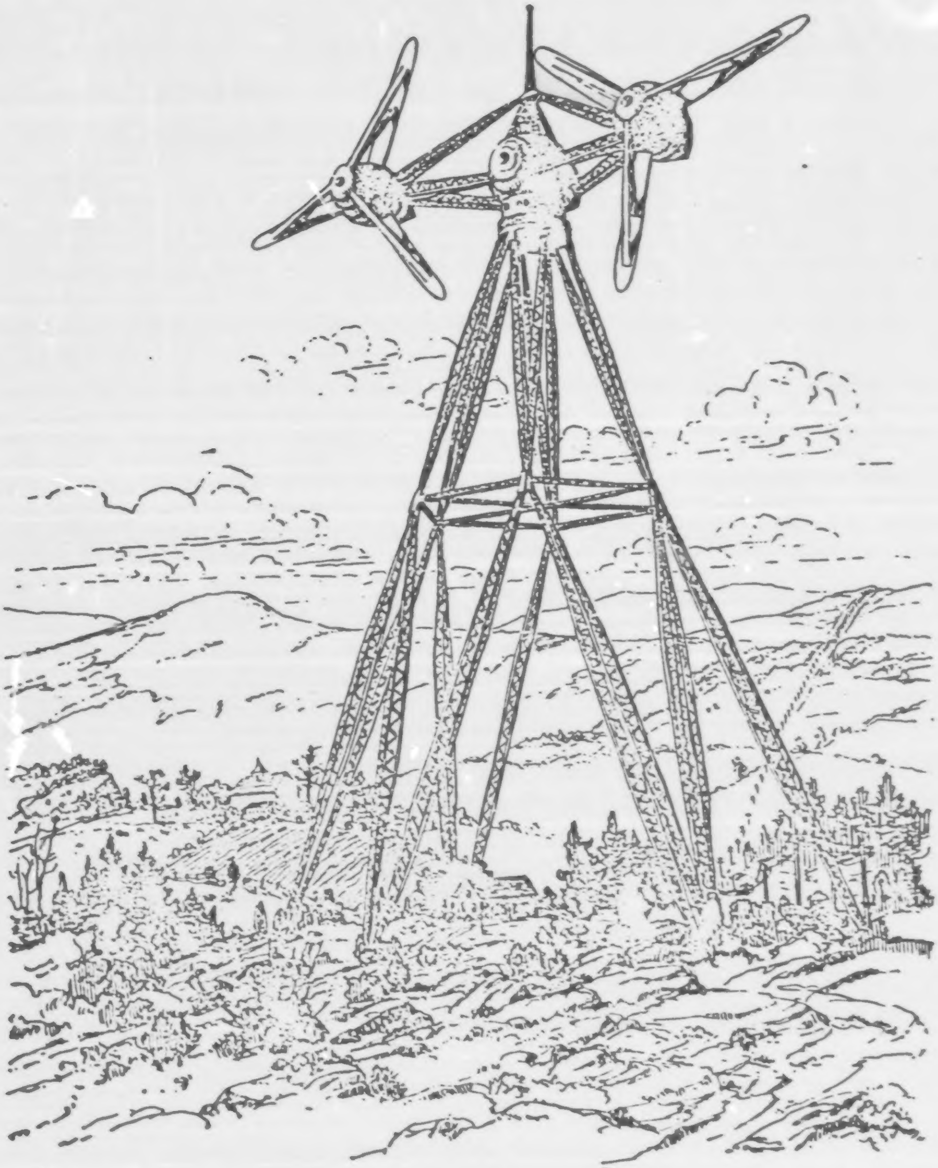
By constructing and using an anemometer, students will acquire some feeling for wind speed and its impact in an ecosystem. Areas of higher wind speed such as a waterfront, high elevation or island can be suitable sites for harnessing wind energy. To run an economically efficient windmill, there needs to be an average wind velocity of 15 mph (at oil costs of $10-$11 per barrel).

## Before You Begin

Materials: plastic, transparent soda straw; single edge razor blade; very small styrofoam ball (to fit inside straw), 3 pieces of stiff, corrugated cardboard, 5 cm wide, same length as straw; 2 straight pins; small piece modeling clay; 2 rubber erasers cut from pencils; tape; copies of Student Page

## Words To Know

anemometer, velocity, calibration, abiotic



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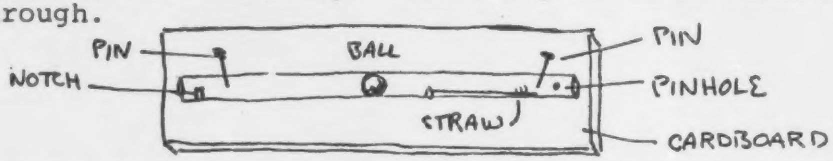
# ACTIVITY

1. At one end of the straw cut a small notch 1 cm from the end with a razor blade. Be careful not to cut through the straw or your finger!

2. At the opposite end, on the same side, make a pinhole .5 cm from the end.

3. Tape the three pieces of cardboard together, one on top of another to make three thicknesses.

4. Put the styrofoam ball inside the straw. Center the straw on the cardboard with notch up. Put the pins in as indicated. Push pins through.



5. Put erasers on the ends of the pins on the wrong side of the cardboard.

6. Plug the notched end of the straw with the clay. This is the bottom of your anemometer.

7. The students will calibrate the anemometer with two scales -- low speed and high speed, indicated on either side of the straw. The low speed scale will be measured with the open end of the straw uncovered. The second scale (high speed) will be done with the open end covered.

8. To calibrate the scales, the students will hold the anemometer out the window of a car driven (by a parent) at uniform speeds. The driver should start at 1 mph. The end of the anemometer should be uncovered. Mark the cardboard where the styrofoam ball is. Have the driver proceed at 1 mph intervals. On the other side of the straw, calibrate the high speed scale. Mark the scale on the cardboard at intervals of 10 mph.

9. During class, when the anemometers are completed, ask students to go outside to measure wind velocity at various locations around the school. Ask them to determine the most likely site for a windmill.

10. Ask students to write statements of conclusion about wind effects:
    a. Higher wind speeds occur at tops of hills.
    b. Wind effects around buildings are most pronounced on the windward side, corners and rooflines.

## Resources

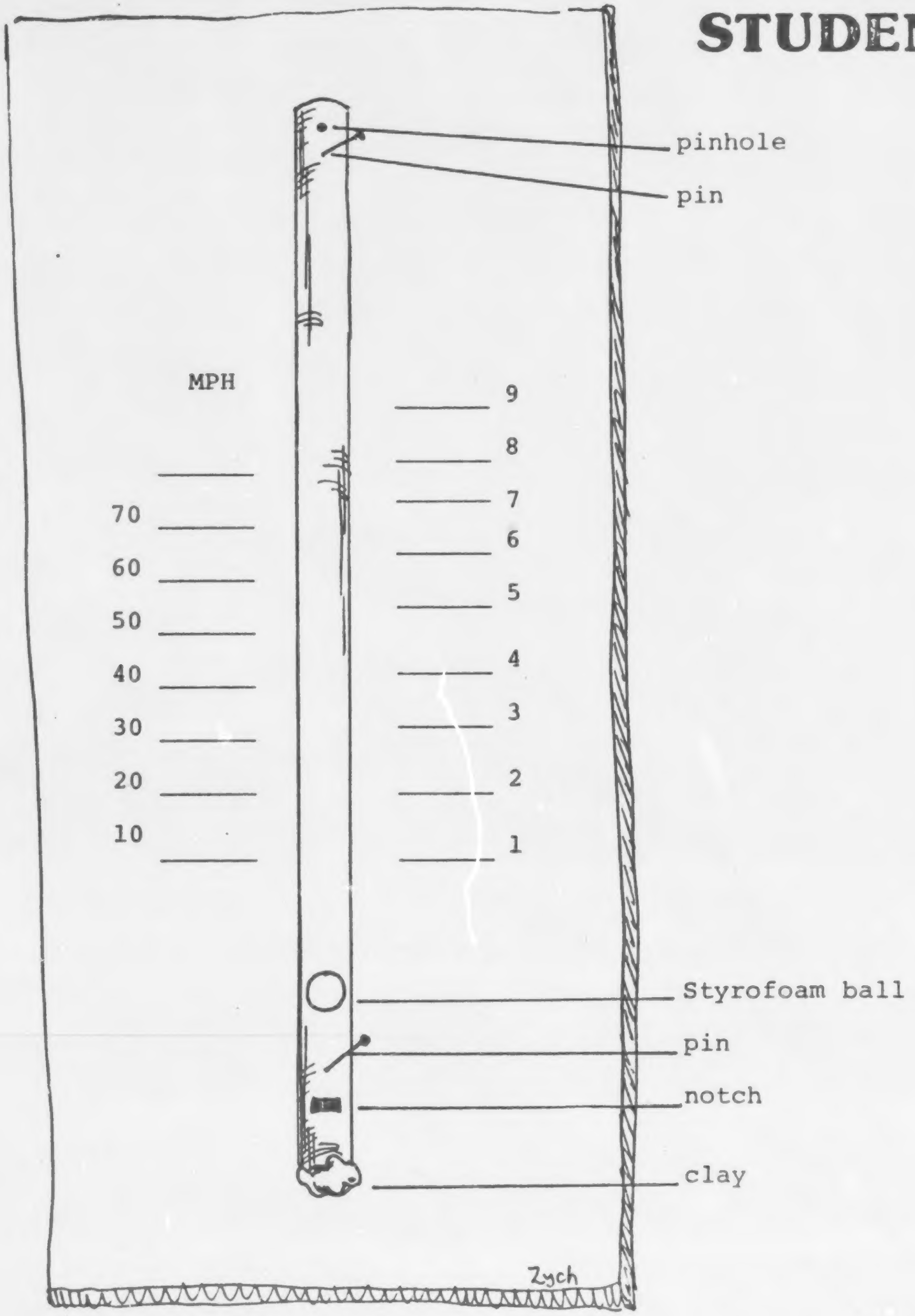
Dennis, Landt, Catch the Wind, Four Winds Press, New York, 1976

## Credit

"Stormy Weather", Individualized Science Instructional System, Ginn & Company, 1976.

Drawings: Cecelia Zych

# STUDENT PAGE


pinhole
pin
MPH
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
Styrofoam ball
pin
notch
clay
Zych

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# Some Like It Cool

**Curriculum Topic**
Thermodynamics

**Grade Level(s)**
6

**Site**
Classroom

**Skills**
Collecting, compiling and interpreting data

**Energy Topic**
Energy Sources
Energy Conservation

**Credit** Smith, S. ed., Energy-Environment Mini-Unit Guide, National Science Teachers Assoc., 1975. "Ideas and Activities for Teaching Energy Conservation," Environment Center, University of Tennessee, 1977. Adapted by Paul Kubicza in EARTHWATCH, Vol. II, ACES, New Haven, CT, 1978

## Objective

The student will be able to:

1. identify the direction of heat energy transfer between hot and cold environments.
2. classify a variety of common insulation materials

## To The Teacher

Thirty percent of the national use of electricity during the summer consists of air-conditioning for homes and apartments. Power system overloads with brownouts and blackouts during very hot weather are increasingly likely. The relationship between keeping things cool and insulation is investigated in activities in which students try to prevent the melting of ice cubes. The desirability of insulating homes to use less electricity is examined through student experiments and classroom discussion.

There are three types of thermal insulation widely used in homes today. The first type consists of batts or blankets of mineral wool (this may be either fiberglass or rock wool) which comes in a variety of thicknesses and in several different widths. Second is loose fill, also made of mineral wool, which comes in bags so that it can be poured between attic beams or into hollow wall cavities. Third is urea formaldehyde foam which is pumped into attics and hollow wall cavities by franchised applicators.

Insulation efficiency is measured in R-values. The R-value of a substance is a measure of its thermal resistance. Seven inches of fiberglass insulation is an excellent insulator with an R-value of 19. One-half inch plywood is a poor insulator with an R-value of only 0.62. House walls should have insulation with an R-value of at least 13 (3-1/2 inches of insulation), and ceilings should have insulation with an R-value of at least 19.

One of the laws of thermodynamics is that warm things have more heat energy than cold things, and when a warm thing is placed near or around a cold thing, some of that heat energy is transferred or flows to the cold thing. By wrapping or enclosing the ice cube in this activity, students slow down the transfer of some of the heat energy in the room to the ice cube. The results of the game indicate that some materials can slow down the transfer of heat energy more than others. These materials are called insulators.

## Before You Begin

Materials: approximately equal-size ice cubes (1 per student and teacher)
plastic bags (small sandwich bags to hold ice cubes and water)
insulating materials (collect as many as possible):
paper-various thicknesses
cardboard-different types and thicknesses
styrofoam coffee cups
paper cups
glass tumblers or beakers
metal cups or cans
plastic food containers
transparent food wrap
wax paper
newspaper
foam rubber
vermiculite
sand
small wooden containers
cotton balls
different types of cloth (wool, cotton, nylon, fake fur, etc.)
anything else you can think of

Note: Average size ice cubes take approximately 2 hours to melt. The lab takes 10-15 minutes to start. If your schedule does not give you this much time, you can use the small sized ice cubes that are about 1 cm. across.

Preparation: Prepare classroom copies of "Insulating Materials In the Home."

## Words To Know

heat flow, insulator, R-value

# ACTIVITY

1. Inform students that you have collected some materials for an interesting game that anyone can play. Tell the class that each team of students will be given an ice cube and the goal of the game is to prevent the ice cube from melting for the longest time possible.

2. Show the class the materials that can be used. Have each group gather the material they will use to try to preserve the ice cube. Encourage groups to choose different materials and means of wrapping. (Note: If time is limited you may stop the activity here and continue with Step 3 the next day.)

3. Give each group an ice cube in a plastic bag. Have them wrap the bag with the materials they selected.

4. As a control place 1 ice cube in a plastic bag where all students can see it. Be sure to record its dimensions (in cm) before you start. This is necessary since some groups may bury or cover their bag and the cube will not be visible.

5. The control ice cube will be used as a timer. When it is almost completely melted the game ends. This takes from 1/2 to 2 hours depending on the size of your ice cubes.

6. When the timer ice cube is almost melted signalling the end of the game, have all student retrieve their ice cubes and measure them in cm. Avoid touching the ice cubes.

7. Compare the class results. You can put a chart on the board or overhead projector and record the results as follows:

| Group | Insulating Material | Size of Cube at End of Game |
|---|---|---|

The following questions may be of value in analyzing the results:

- a. How long did it take the timer ice cube to melt?
- b. Were any ice cubes still unmelted?
- c. Which materials were best at preserving the ice cube?
- d. Did the thickness of the material make any difference?
- e. Why did the ice cubes melt?
- f. Which materials slowed down the transfer of heat toward the ice cube more than others?
- g. Define insulator. Ask which materials are the best insulators? the poorest insulators?
- h. Why is home insulation vital during a hot summer?
- i. What type of materials would make the best home insulators?

8. Pass out copies of "Insulating Materials In the Home." Discuss the meaning of R-values. Discuss which material would preserve the ice cube the longest. Relate the thickness of insulation to R-value.

## Related Activities

1. Discuss examples in which insulation is used to keep things cold.

2. Have students bring milk cartons to class. Conduct a game in which students try to find the best way to insulate their house (the milk carton). Use an ice cube and various insulating materials.

3. Discuss how a thermos bottle keeps a liquid cold.

4. Have students make up a list of good insulators and a list of bad insulators.

5. Discuss the following question: "Why does insulation that keeps a home cool in summer also keep it warm in the winter?"

## Resources

Abraham, N., Balch, P., Chaney, D., and L., Rohrbaugh, Interaction of Matter and Energy, Rand McNally, 1973, p 272-273.

Heimler, C., and J. Price, Heat, Light and Sound, Merril Publishing Company, 1977, p 5-9.

## Credit

Smith, S., ed. Energy-Environment Mini-Unit Guide, National Science Teachers Association, 1975, p 101-106

"Ideas and Activities for Teaching Energy Conservation", Environment Center, University of Tennessee, 1977

## Notes To Myself

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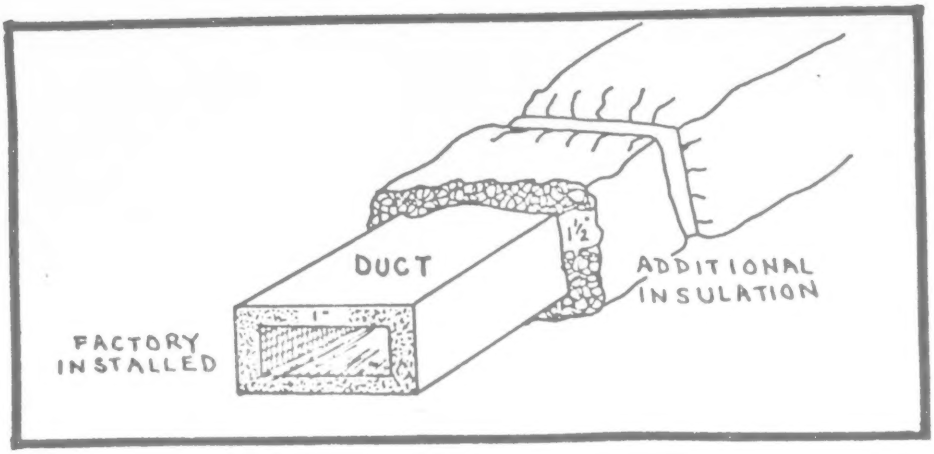
# STUDENT PAGE

## INSULATING MATERIALS IN THE HOME

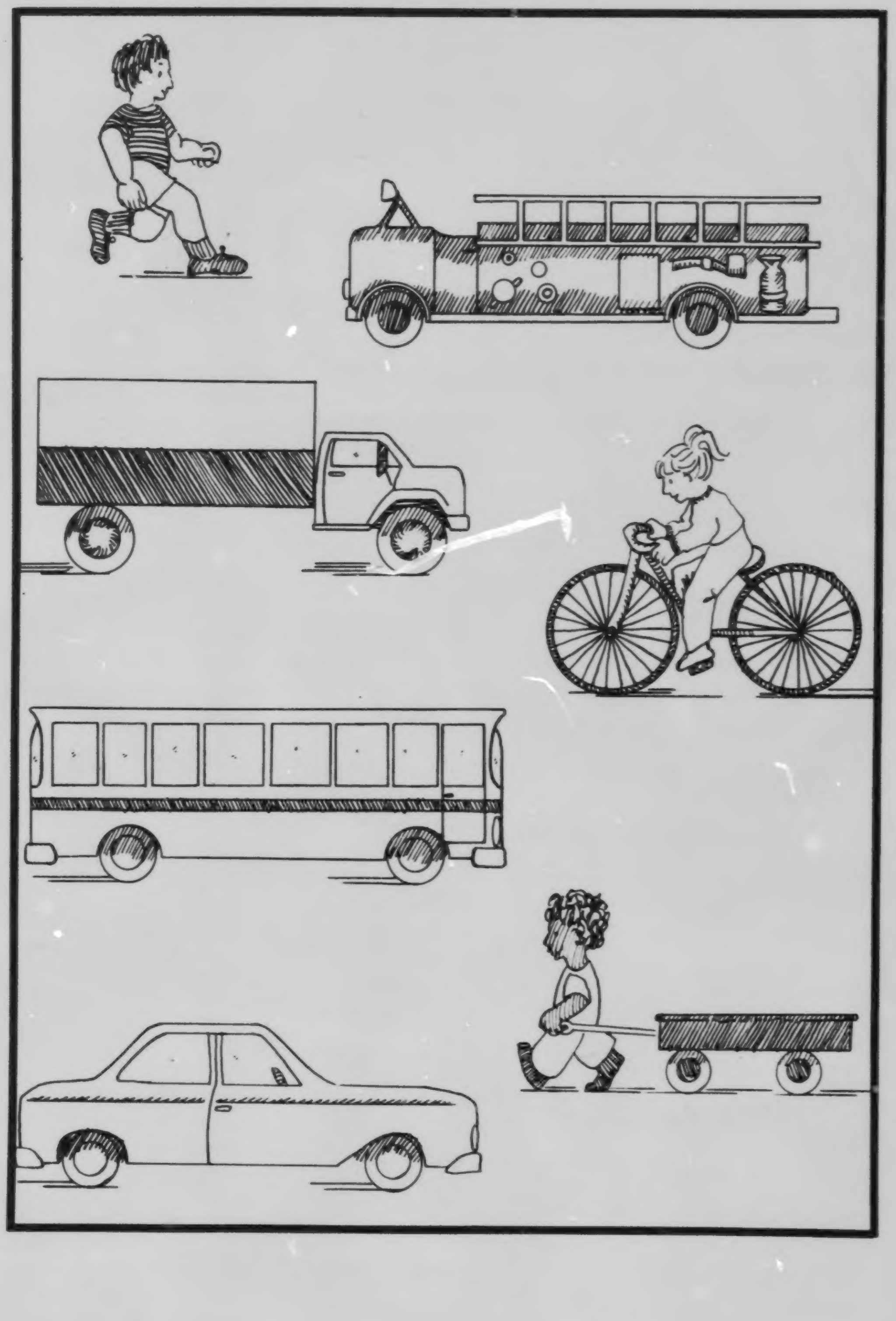
| | MATERIAL | R-VALUE |
|---|---|---|
| 1. | ½ INCH GYPSUM BOARD | 0.45 |
| 2. | ½ INCH PLYWOOD | 0.62 |
| 3. | COMMON BRICK, PER INCH THICKNESS | 0.20 |
| 4. | FLOOR TILES | 0.05 |
| 5. | CARPET AND FIBER PAD | 2.08 |
| 6. | CARPET AND FOAM RUBBER PAD | 1.23 |
| 7. | 3/8 INCH ROOF | 0.33 |
| 8. | 1 TO 4 INCHES OF AIR SPACE | 1.00 |
| 9. | 2 TO 2½ INCHES OF INSULATION | 7.00 |
| 10. | 3 TO 4 INCHES OF INSULATION | 11.00 |
| 11. | 5 TO 7 INCHES OF INSULATION | 19.00 |

THE R-VALUE IS A MEASURE OF THE RESISTANCE OF A MATERIAL TO HEAT FLOW. MATERIALS THAT HAVE HIGHER R-VALUES ARE BETTER INSULATORS.



Duct Insulation.

# ENERGY USES



# ENERGY - USES

ACTIVITY TITLE PAGE NUMBER

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A LOOK AT LEISURE.........................................93

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"HOW CAN I GET THERE?"...................................107

HOT WATER & ENERGY CONSUMPTION...........................110

## ENERGY-DEMANDS AND USES/OUR NEEDS

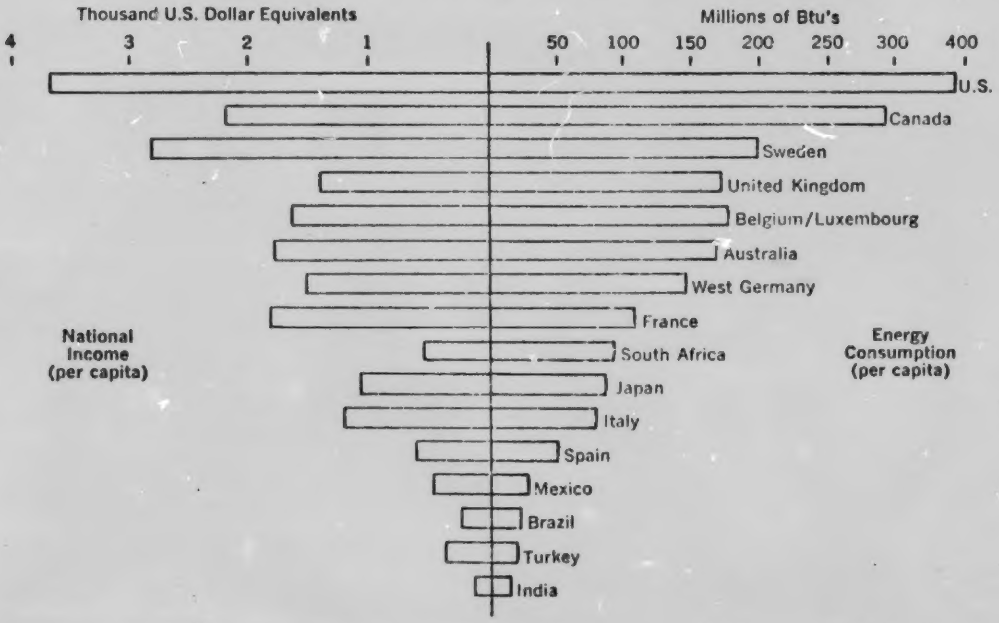
"The United States consumed almost 69 million billion ($69 \times 10^{15}$) Btu's of energy in 1971. This energy provides the driving force for our transportation systems; heat, light, and mechanical power for our industrial, commercial, and residential uses; and electromagnetic energy for communications.

The Nation's annual rate of growth in total energy demand between 1950 and 1970 was about 3.6 percent, while the annual rate of increase in the gross national product was 3.6 percent and population growth averaged 1.5 percent. Thus, economic growth and the attendant growth in per capita energy consumption have been more directly correlated with total growth in energy demand than has population growth. We continually demand additional energy-intensive goods and services, a demand which in turn encourages more energy use to increase the productivity of labor and capital.

The productivity of heavy industry, agriculture, transportation, and services has been substantially increased by energy-intensive tools, from jet aircraft to computers. For virtually all nations, the developing as well as the developed, the larger the per capita gross national product, the larger the per capita energy consumption. This relationship is seen in Figure 1. The shift from an agrarian to an industrial economy results in vast increases in energy consumption both for powering the industry and for mechanizing and fertilizing the farms to increase productivity. In addition, an energy-intensive transportation system ties together any highly interdependent economy.

Figure 1

Per Capita Income and Energy Consumption, 1968



Source: U.S. Department of the Interior. 1972. *United States Energy—A Summary Review*. Washington, D.C.: U.S. Department of the Interior, p. 2.

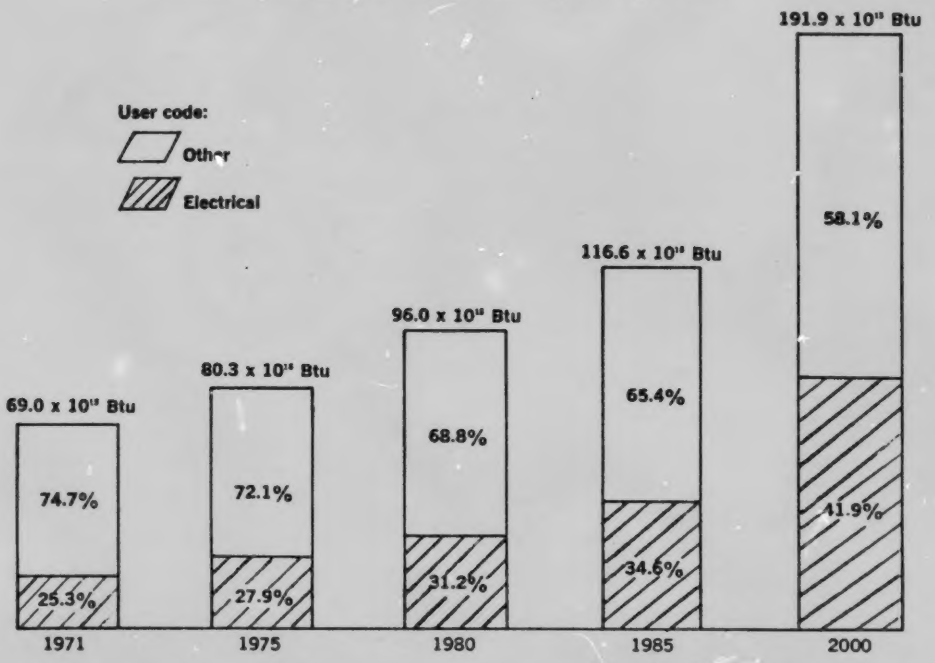
As a society becomes more wealthy, it can and does provide more goods and services that require larger amounts of energy. These include automobiles, larger homes, and labor-saving appliances. The climate and economic specialization of a region, as well as the cost of energy, can affect the relationship between energy consumption and standard of living. Nevertheless, it is reasonable to expect that as a nation increases its per capita income, its consumption of energy will also rise.

One major trend in energy demand must be emphasized--dramatically increased use of electricity. Over the past decade, electricity consumption has grown at a rate of 7 percent annually, double the growth rate of all other energy uses. By the year 2000, it is likely that over 40 percent of all energy will be used to produce electricity, as shown in Figure 2.

A good example of the strong relationship between energy consumption and standard of living is the American home, where more new energy-intensive electric appliances are added each year. Air conditioners, dishwashers, and clothes dryers, all luxury items in the 1950's are commonplace today. Growing suburban areas, with new homes employing many of these appliances, are among the largest residential users of electricity. For example, residential customers in the affluent suburbs of Alexandria, Virginia, and Bethesda, Maryland, consume about twice as much electricity per household as those in Washington, D.C.

**Figure 2**

**Estimated Total Energy Use and Energy for Generating Electricity, 1971–2000**



Source: Based on Dupree, Walter G., Jr. and James A. West. December 1972. *United States Energy Through the Year 2000*. U.S. Department of the Intericr. Washington, D.C.: Government Printing Office, Table 4.

These trends in the residential sector are mirrored in the commercial sector, in which growth of all types of electric appliances is seemingly without end. Heated garages, escalators, and temperature-controlled sports stadiums typify increased energy use by the commercial sector. The Houston Astrodome, for example, used enough electricity in 1971 to satisfy the annual electrical demand of 8,183 households.

Energy used for transportation has also increased steadily. Twenty-five percent of the Nation's energy demand is for transporting people and materials. Of this total, automobiles account for 55 percent, trucks 21 percent, aircraft 8 percent, railroads 3 percent, and other transport modes, including buses and pipelines, the remaining 13 percent.

The increasing use of energy for transportation reflects not only growth in the number of passenger-miles traveled but also the change to more rapid and more convenient transport modes that use more energy. For example, there is now about one automobile for every two people in the United States. The 2-car family is a way of life, and 3- and 4-car families are no longer uncommon. The shift in urban and intercity transport to more energy-intensive modes of travel is shown in Table 1. Freight transport has also become more energy intensive. In the last 20 years, air and truck transport volume has grown dramatically while more energy-efficient but slower or less convenient rail and waterborne freight has increased only slightly.

*Table 1*

**The Shift to Energy-Intensive Passenger Transport**

| | Percent of total passenger-miles | | | Average Btu's per passenger-mile | Load factor |
|---|---|---|---|---|---|
| | 1950 | 1960 | 1970 | | |
| Urban | | | | | |
| Walking | | NA | NA | 300 (human energy) | 1 |
| Bicycle | | NA | NA | 180 (human energy) | 1 |
| Bus | | 5.9 | 2.7 | 2,100 (diesel fuel and gasoline) | [1] .36 |
| Automobile [2] | | 89.2 | 94.5 | 8,100 (gasoline) | [1] .28 |
| Intercity | | | | | |
| Bus | 4.5 | 2.5 | 2.1 | 1,600 (diesel fuel and gasoline) | [1] .45 |
| Railroad | 6.5 | 2.8 | .9 | 2,900 (diesel fuel) | .35 |
| Automobile | 86.8 | 90.1 | 86.6 | 3,400 (gasoline) | [1] .48 |
| Airplane | 2.0 | 4.3 | 10.1 | 8,400 (gasoline and jet fuel) | .50 |

[1] Based on 50-passenger average capacity for buses and 5-passenger capacity for automobiles.

[2] Includes taxicabs.

Sources: Transportation Association of America. 1972. *Transportation Facts & Trends, Ninth Edition.* Washington, D.C.: T.A.A., p. 16; U.S. Department of Transportation. July 1972. *1972 National Transportation Report.* Washington, D.C.: D.O.T., p. 189; personal communication with Richard Strombotne, U.S. Department of Transportation; Rice, Richard A. 1971. "Historical Perspective in Transport System Development," in *Advanced Urban Transportation Systems.* Pittsburgh, Pa.: Transportation Research Institute, Carnegie-Mellon University, p. 89; and Hirst, Eric, and Robert Herendeen. January 1973. "Total Energy Demand for Automobiles." A paper presented before the Society of Automotive Engineers, Inc., New York, N.Y., International Automotive Engineering Conference, Detroit, Mich. p. 3.

The industrial sector, too, has benefited significantly from easily available, low-cost energy. Although its energy demands are less visible to the public, the production of manufactured goods and agricultural products increasingly depends upon intensive use of energy. Indeed, industry is the largest user of energy today--40 percent of the Nation's total. Energy is needed for all phases of industrial operations; it provides the motive force for minerals extraction, heat and power for resource refining, and mechanical work to facilitate mass production. Manufacturing output more than doubled between 1950 and 1970, while the number of man-hours increased by less than 25 percent--an increase in output per man-hour of almost 70 percent. This growing productivity of labor through energy use is likely to continue. Energy-intensive processes are replacing human labor, partly because labor costs have often risen more rapidly than energy and equipment costs.

The Nation's continuing urbanization, higher speed and greater convenience of transportation for both people and merchandise, and the proliferation of labor-saving devices in all sectors have been stimulated by relatively low energy prices. We now face energy supply problems--availability of natural gas and petroleum; siting, financing, and constructing powerplants and other facilities; dependence on imported oil with concommitant balance-of-payments and national security difficulties; and damage to the environment from development of our resources. These problems are requiring us to consider more carefully our extensive and rapidly rising use of energy."[1]

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[1] Energy and The Environment, prepared by the Council on Environmental Quality, 1973.

WE USE FOSSIL FUELS

## Curriculum Topic

Fossil Fuels

## Energy Topic

Energy Sources
Energy Uses

## Grade Level(s)

2, 3

## Site

Classroom

## Skills

Communicating information, listening with comprehension, observing, constructing models

## Credit

Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN 1977.

## Objective

Students should be able to:

1. Identify three fossil fuels: coal, oil, and natural gas.
2. Recognize the many ways we currently use fossil fuels.
3. Recognize that, when used up, fossil fuels are completely gone.

## To The Teacher

Coal, oil and natural gas are commonly called fossil fuels because they were formed from the fossil remains of ancient plants and animals over millions of years. Fossil fuels must be burned before energy can be released. Once burned they are gone. This energy is non-renewable.

Coal is found underground all over the world. It is collected through mining and transported by railroad car, truck, barge or freighter. Heat from burning coal is used in many industrial processes such as in making steel. Coal heat is also used to run electric power plants. The coal heats water to form steam which turns the turbine and generate electrical energy.

Oil found under the ground and under the sea is collected by drilling, and transported by pipelines and in oil tankers. Oil has many uses. It is burned in diesel engines, in trains and in trucks. It is converted to gasoline and used in cars. It can also be used to provide heat energy to run electric power plants.

Natural gas is found in underground wells, is collected by drilling and transported by pipe lines and gas tankers and stored in tanks until used. Natural gas is burned in furnaces and stoves in homes, offices and factories.

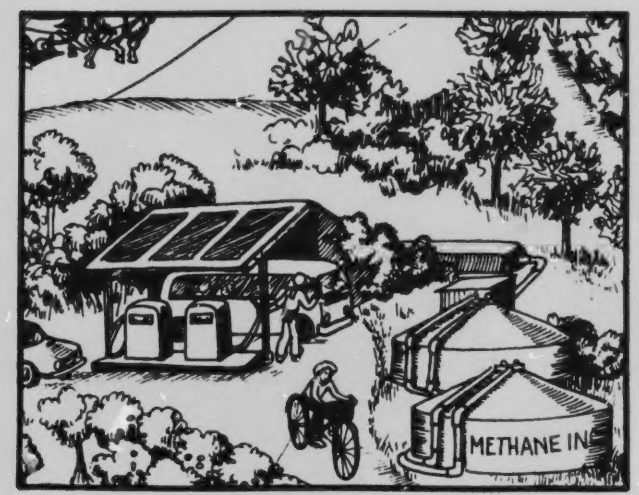
## Before You Begin

Duplicate class copies of the Student Pages. Assemble the following needed class materials:

Samples of oil and coal
String
Scissors
Crayons
Paste
Blue and black construction paper
Paper punch
Milk cartons

## Words To Know

oal, oil, natural gas, fossil fuel, non-renewable



# ACTIVITY

Part A

1. Distribute the pictures showing the kitchen and the outdoor picnic scene (Picture 1). Ask the children to find things in each of pictures which give off heat of light. Color these orange.

2. Discuss where the heat or light comes from. Their answers will probably be electricity, which usually uses water or coal for power; gas, referring to natural gas; or coal. Discuss the fact that these have to be burned to give off energy.

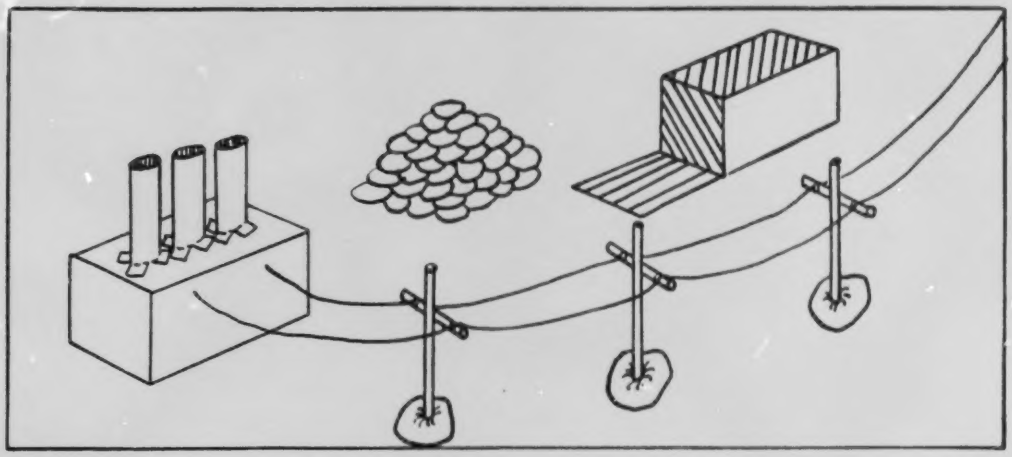
3. Help the children recognize that coal is often used in power plants to make electricity. Cut out the parts on illustration 2a and b to build a power plant with its accompanying coal pile and power lines. You can make this simpler or more complex depending on the ability of your class.

4. Have your class work individually or in small groups. Duplicate the plans for the generator (2a and b). Have the children cut out the parts. Fold on the broken lines and fasten together by putting paste on the tabs.

Some group might tear small chunks of black paper and pile these "pieces of coal" beside the generator to make a coal pile. Others can make a dam to represent water power as the source of energy.

5. The thicker rectangular pieces can be rolled to make the smokestacks. Cut up on the lines and bend outward on the broken lines to make tabs to fasten the smokestacks on the roof of the power plant.

6. Roll up the telephone poles, put holes in the top with a small hole punch, and string electric wires from the plant to the poles and on to any simple milk carton houses you might devise. The poles can be kept upright by inserting one end into a clay base.



Part B

1. In picture 3 find things that need gasoline or oil in order to move. Put a circle around them.

Explain to the class that gasoline is made from oil which comes from the ground. Oil is a fossil fuel.

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2. Conduct a class discussion on picture 4. You will want to include the following information:

Coal, oil and natural gas are called fossil fuels. These fuels were formed long ago before people lived on the earth. At that time the earth may have looked like the picture .

Long ago these plants and animals lived and died and fell to the ground. More and more of these large trees grew, and they in turn fell to the ground and covered the first ones. Sometimes the land sank and was covered with water and at times it would rise again. More and more trees grew in the swampy forests, only to fall too as they grew old and died.

Through the ages the materials on top became heavier and heavier and the plants and animals were pressed harder and harder. Gradually they changed into coal, oil and natural gas. This process took millions and millions of years.

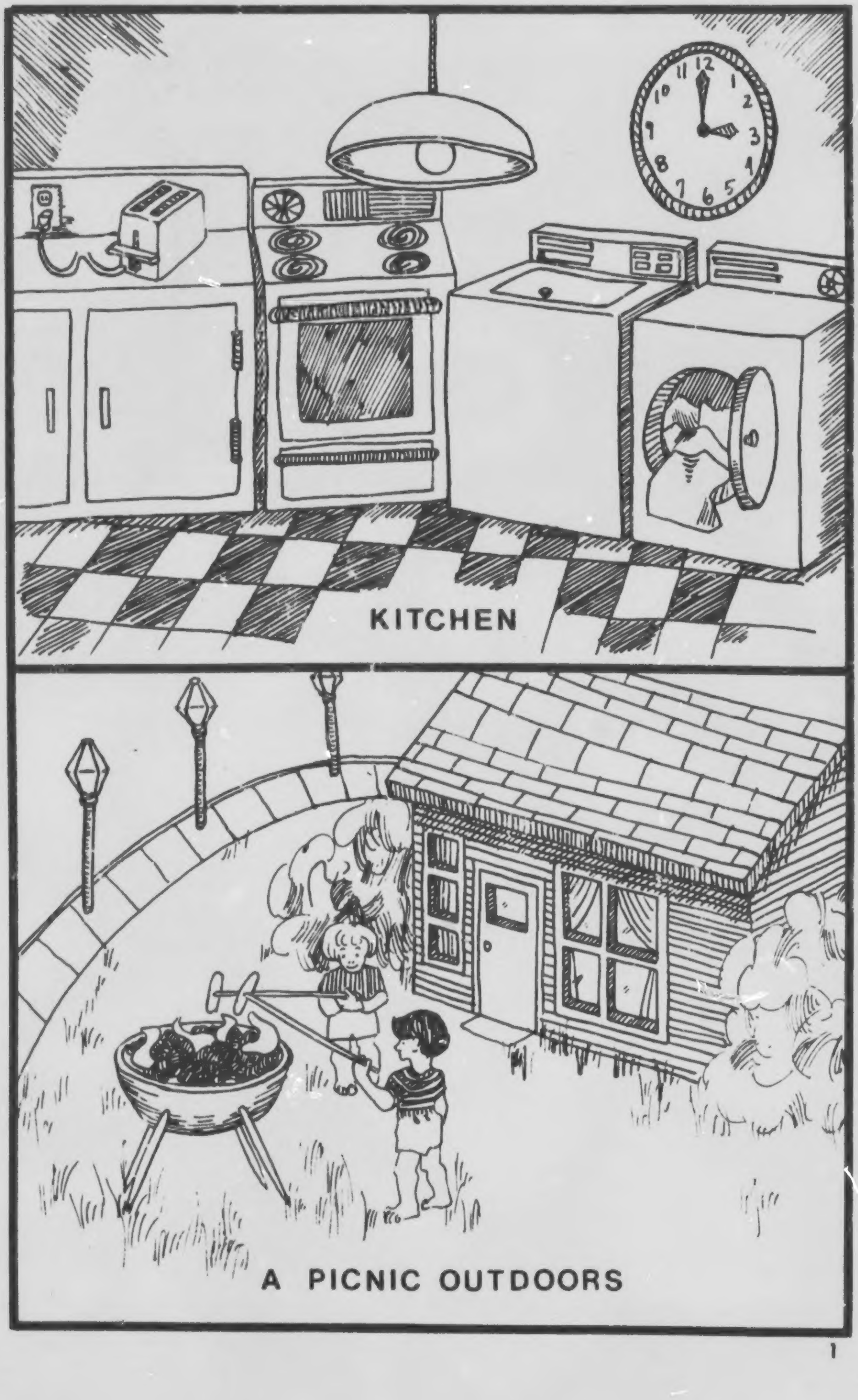
Since this all happened before there were people on the earth, how do we know about these plants and animals which lived so long ago? Sometimes they leave records. These records are called fossils.

3. Examine samples of oil and coal and remind the children how long ago this was made. Once used it is gone forever. We cannot get it back. We say it is non-renewable.

## Notes To Myself

# STUDENT PAGE

Which give off heat or light?
Color them orange.


KITCHEN
A PICNIC OUTDOORS

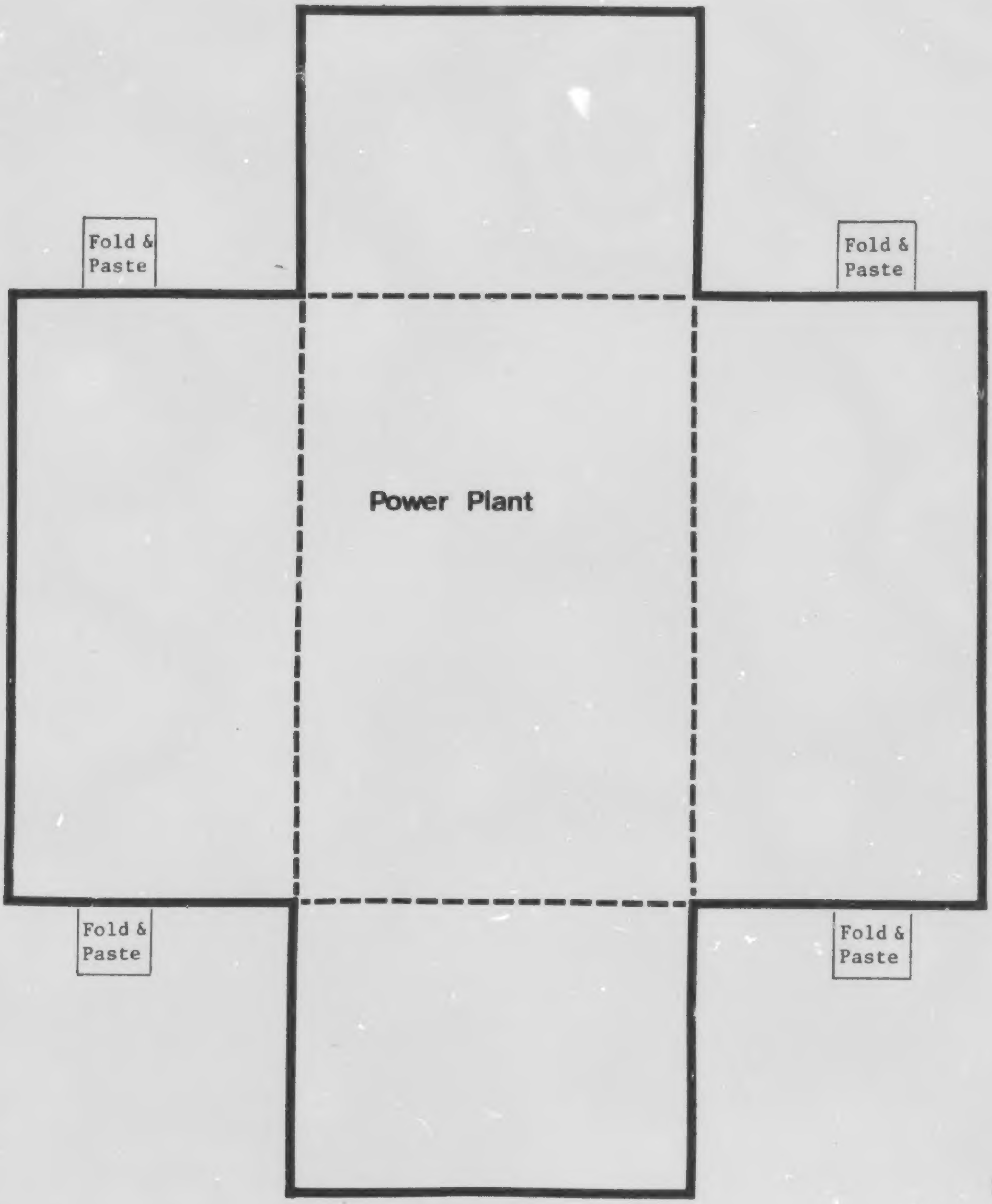
# STUDENT PAGE

**Telephone pole**

(Roll and put into clay base)

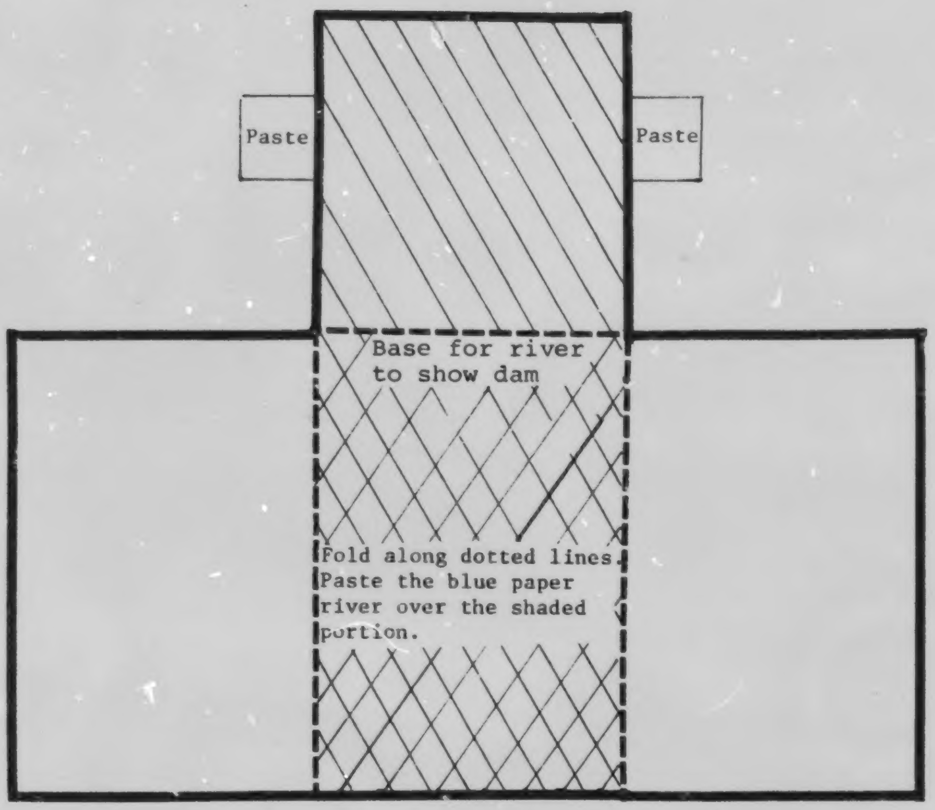
**Utility pole**

(Roll and put into clay base)

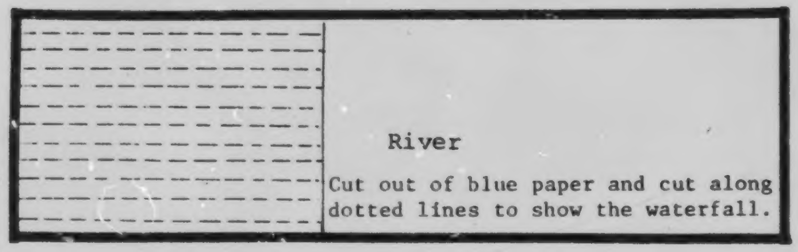

Fold & Paste
Fold & Paste
Power Plant
Fold & Paste
Fold & Paste

2a

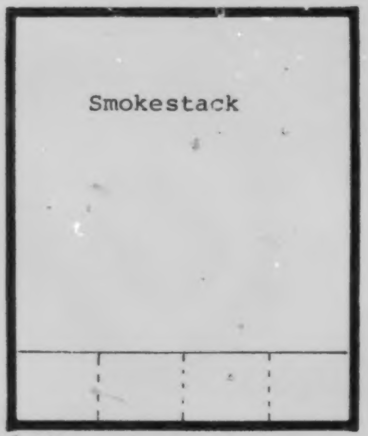
# STUDENT PAGE

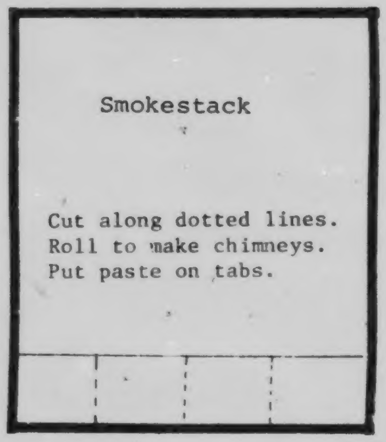

Paste
Paste
Base for river to show dam

Fold along dotted lines. Paste the blue paper river over the shaded portion.

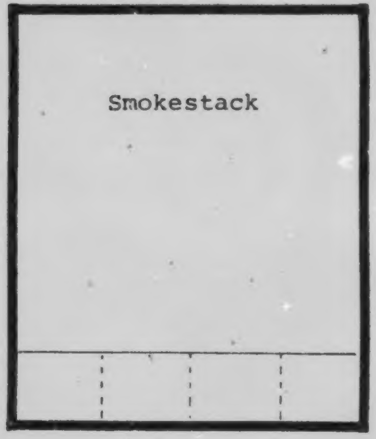


Cut out of blue paper and cut along dotted lines to show the waterfall.


Smokestack


Smokestack

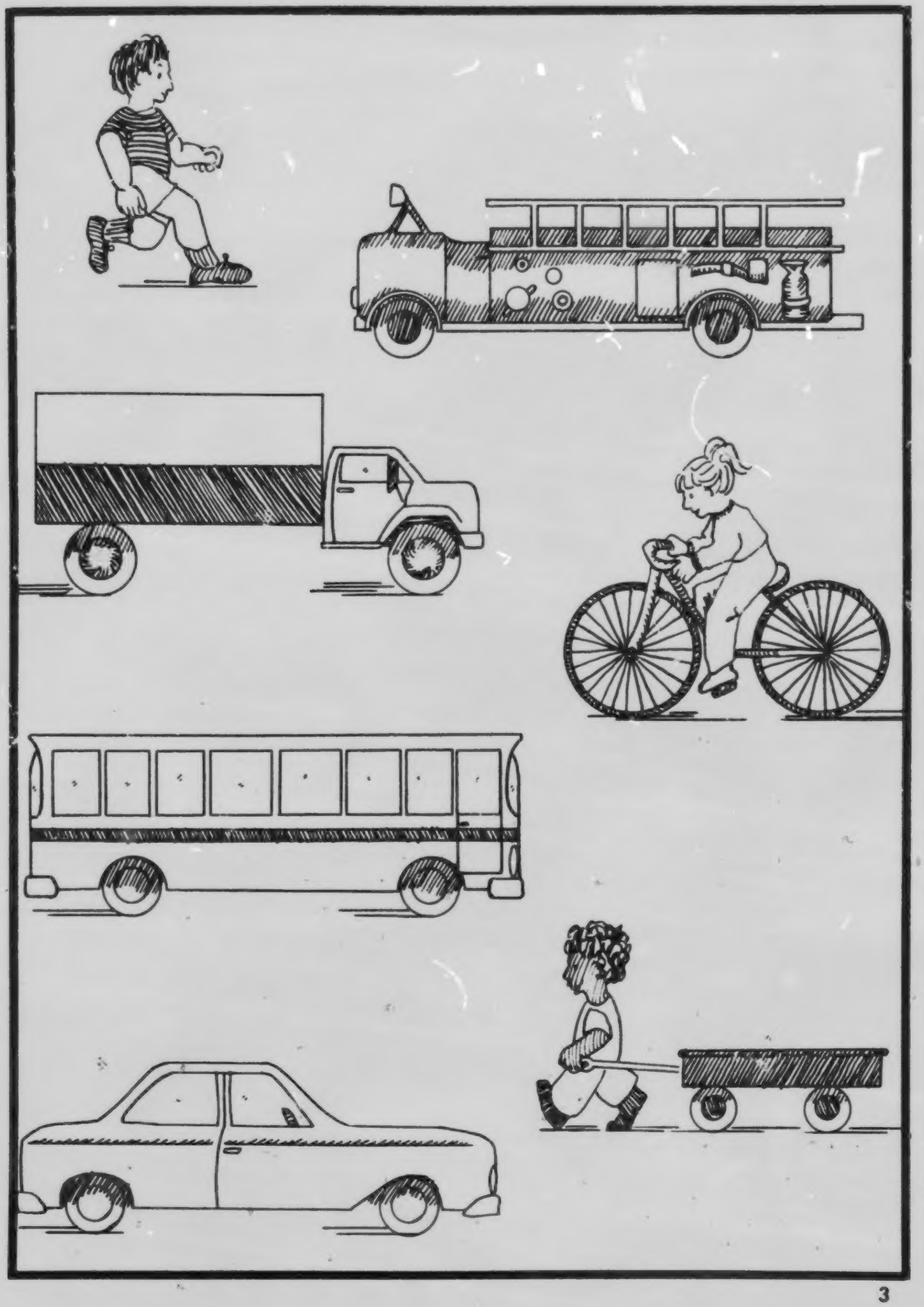
Cut along dotted lines. Roll to make chimneys. Put paste on tabs.


Smokestack

**2b**

# STUDENT PAGE

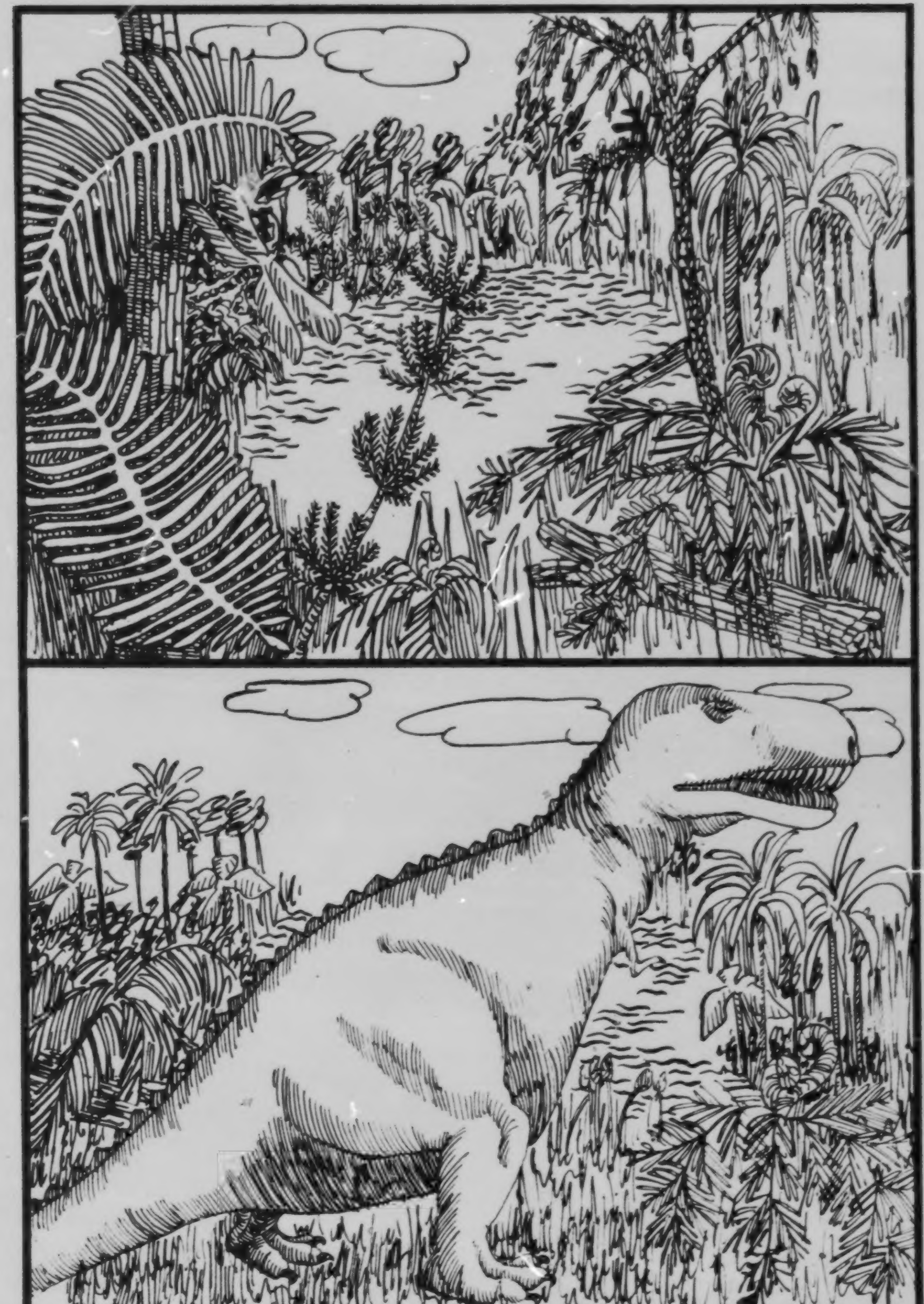
What things need gas or oil to move?
Circle them.



3

# STUDENT PAGE

## MANY, MANY YEARS AGO



4

# Solar Collectors

## Curriculum Topic

The Sun as a Source of Energy
Heat

## Energy Topic

Energy Sources
Energy Uses

## Grade Level(s)

4-6

## Site

Classroom, schoolgrounds

## Skills

Experimenting
Observing
Constructing a model

**Credit** Paul Sanderson, in EARTHWATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT 1978.

## Objective

The student will be able to:

1. manipulate apparatus by constructing a solar collector which can be tested to determine its ability to generate heat
2. illustrate the principle of solar energy collection.

## To The Teacher

Sunlight is one of many forms of energy used by people today. It is possible to use this infinite form of energy to replace finite energy resources now in use. Currently, sunlight can heat water for our homes and offices, and can be converted to heat air to provide warmth throughout most of the year. This conversion is accomplished through the use of solar collectors, which absorb the heat of the sun and transfer it to a useable medium such as water or air. In this experiment, the students will themselves be able to collect sunlight and use it to generate heat.

## Before You Begin

MATERIALS: oaktag or cardboard, heavy duty aluminum foil, coffee cans, masking tape, thermometers (registering over 200 degrees F), notebooks or paper, pencils

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PREPARATION:

1. Build a model solar collector. Cover a full-sized sheet of oaktag with heavy-duty aluminum foil, shiny-side out. (See diagram 1). Tape the foil down securely. With foil on the inside, roll the short side of the oaktag into a cone shape, with a large opening at the top and a small opening (2"-3" in diameter) at the bottom. (See diagram 2). Tape the oaktag securely to keep the cone in this shape. You should end up with a large, foil-lined, open-ended cone (See diagram 3). Students may have some difficulty in making this shape. Fortunately, many variations will work well enough to illustrate the concept.

CAUTIONS:

1. Never look directly at the sun, even through dark glasses, lenses or mirrors.

2. Some collectors will reach temperatures of 200 degrees F and more. Be careful of this heat.

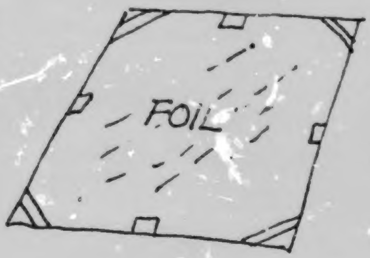

Diagram 1

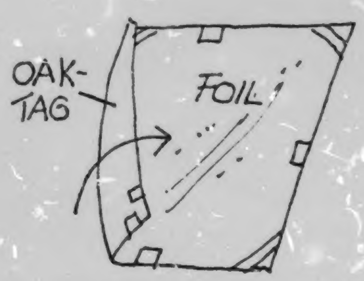

Diagram 2

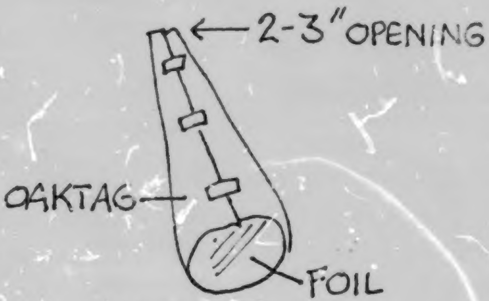

Diagram 3

## Words To Know

solar collector, cardinal point

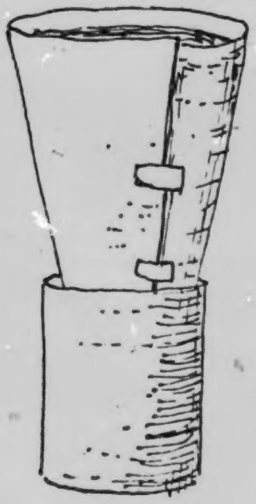

Diagram 4

# ACTIVITY

1. Display the model solar collector.

2. Distribute materials to each student: oaktag, foil, tape and scissors.

3. Demonstrate how to make a collector.

4. Allow students to work at their own paces until each has completed a collector.

5. Place the small end of each collector into a coffee can. (See diagram 4).

6. Go outside to test the collectors in the sunlight. Orient the students to the direction, north, south, east west.

7. Place your thermometers in the coffee can and at other positions within the cone, to determine the heat generated. Have the children record in their notebooks the temperature in the collector, the temperature of the air, time of day, and the weather conditions. Encourage more experimentation: different times of day, under different weather conditions, etc.

8. Discuss:

   a) How did you make your solar collectors work most efficiently?

   b) What did the aluminum foil do to help collect the sun's heat energy?

   c) What weather conditions gave the best results? Why?

   d) In which cardinal direction (N,S,E,W) did you usually point your solar collector?

   e) What things found in nature collect and store the sun's energy? (rocks, sand, water, plants) What things created by man collect the sun's energy? (blacktop, cars, greenhouses)

   f) What uses can you find for the sun's energy?

## Related Activities

1. Test the collectors on a cloudy day.

2. Cook food (such as marshmallows, toast, popcorn) in the collectors.

3. Experiment with other shapes and designs for solar collectors: boxes, parabolas, dishes, pyramids, etc. Compare the ability of each to generate heat.

4. Visit a solar-heated house, business office, swimming pool, etc.

5. Experiment with silocone solar cells and their uses.

## Resources

Daniels, Farrington, Direct Use of the Sun, Yale University Press, 1964,

Sun, ed. Stephen Lyons, Friends of the Earth, 1978

Anderson, Bruce, The Solar Home Book, Cheshire Books, 1976,

# A Look at Leisure

## Curriculum Topic

Culture
Recreation

## Energy Topic

Energy Uses
Energy Conservation

## Grade Level(s)

4-6

## Site

Classroom

## Skills

Organizing information
Analyzing information
Identifying alternatives
Identifying feelings for alternatives

**Credit** Pat Krukowski, in EARTHWATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services New Haven, CT 1978.

## Objective

Students will be able to examine the relationship between recreational activities and energy usage.

## To The Teacher

With increased technology, mechanization has taken over many areas of our lives, and increased mechanization requires more energy resource consumption. The pattern of recreational activity in the United States is in many instances geared to high energy use. Many "sports" and leisure-time activities rely less and less on human energy output and more on mechanized devices which consume energy at high costs.

In the discussion section of the activity, students may be surprised when they actually tally up and see how much of their personal recreational activity requires large amounts of energy from our environment.

## Before You Begin

Each student will need a copy of the chart on which they will list recreational activities and fill in information about these activities.

# ACTIVITY

1. Distribute the Recreational Activities Chart to each student.

2. Ask students to list 10 recreational activities in which they participate or have an interest. Stress that these need not all be sports, but anything engaged in for recreation (watching a baseball game on TV, playing tennis, sailing, riding a motor bike, going to a movie, camping, etc.).

3. Next, students will judge the healthfulness of each activity and record their conclusions by checking the appropriate column on Recreational Activities Chart.

4. The next column heading is blank. Instruct students to fill in the title: Type of Energy Required. For each of their listed activities students then indicate what type(s) of energy is (are) required for them to take part: muscular energy, sun, wind, water, electricity, gasoline, natural gas, coal, etc.

Discussion Questions:

a. How many of your activities require that you use some muscular energy?

b. How many of your activities require that you use large amounts of energy supplied by the environment? Compare columns 5 & 6.

5. Students will next place a check beside each activity on their list which they think their grandparents might have engaged in as teenagers. How has the pattern of recreational activities changed since your grandparents' time?

6. Ask students to rank order (1-10) their activities according to preference (1 - most preferred to 10 - least preferred).

7. Have students rank order (1-10) their recreational activities on the list from the least energy consumptive (1) to the most energy consumptive (10).

Discussion Questions:

a. Is the general pattern of recreational activity revealed by the activity lists one of increasingly high energy use? If so, what can be done about it?

b. What can you do about it?

8. Explain to students: "There is an energy shortage and everyone must cut back energy consumption 50%. You will have to eliminate 5 of your 10 activities. Which would they be? Place a check in the last column.

Additional Discussion Questions:

a. Using the categories on your chart, how would you rate a major event like the Indianapolis 500-Mile Auto Race?

b. How would you compare tent camping with vacationing in a mobile home?

c. In your opinion, is it desirable to build huge sporting arenas like the Astrodome in Texas (an enclosed, climate-controlled arena where many different sports are played)?

## Related Activities

Assign a project in which students research other countries to find out the most popular recreational activities and how this is related to the level of industrialization and energy use in the country.

## Resources

Wheatley, J. and H. Coon, Teaching Activities In Environmental Education, Volume II, Ohio State University, 1974, p 168.

## Notes To Myself

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# STUDENT PAGE

Recreational Activities Chart

| 1 | 2 | | | | | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|
| Activity | Health | | | | | | | | | |
| | very healthful | somewhat healthful | no effect | somewhat harmful | very harmful | | Activities Grandparents Might Have Engaged In? (√) | Rank Preference (1-10) | Rank most energy consumptive (1) to least energy consumptive (10) | Check the five you would eliminate during cutback |
| 1. | | | | | | | | | | |
| 2. | | | | | | | | | | |
| 3. | | | | | | | | | | |
| 4. | | | | | | | | | | |
| 5. | | | | | | | | | | |
| 6. | | | | | | | | | | |
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| 13. | | | | | | | | | | |
| 14. | | | | | | | | | | |
| 15. | | | | | | | | | | |

# Desalt of the Earth

### Curriculum Topic

Matter-physical properties of solutions

### Energy Topic

Energy Sources
Energy Uses

### Grade Level(s)

4-6

### Site

Classroom or laboratory

### Skills

Constructing models, constructing and testing hypotheses.

**Credit** "Build a Water Desalt-Model," *Dolphin Log*, The Cousteau Society, May/June, 1978. Adapted by Steve Gold in EARTHWATCH, Vol. II, Environmental Education Center, ACES New Haven, CT 1978.

## Objective

The student will be able to:

1. build a model desalinization plant powered by solar energy,
2. describe the process of distillation.

## To The Teacher

Life on earth emerged in a watery medium, and is still entirely dependent upon this precious liquid. Though the earth's water resources are constantly flowing through the hydrological cycle, most of the planet's water is at any time, in the vast storehouse of the oceans. Less than 2% of the world's water is fresh, and more than 99% of the fresh water is ice. As water is used in greater and greater quantities, today 6,048 liters of it are used per person per day in the United States, pressure on supplies will increase because of pollution and depletion. The sea, a vast reservoir, may be mankind's water source of last resort.

The problem with seawater for human use is its salinity, which averages about 3.5% by weight. Such water cannot be used for drinking, would ruin cropland if used for irrigation, and would prove far too corrosive for most industrial uses. Removing the salt--desalinization--is essential if ocean water is to be used for human civilization.

Although a variety of desalting methods are being considered, distillation remains the oldest and simplest. Water is evaporated, leaving the salt as residue. The now-fresh water can recondense and is collected. This process goes on in nature all the time as water is evaporated from the ocean surface and recondenses in rain clouds.

Desalinization, for the moment, can at best supplement our fresh water resources. It currently provides less than .001% of the world's needs. Desalting on a massive scale is still far in the future. Two major problems with desalinization are the huge amounts of energy required for even a single desalinization plant, and the problem of what to do with the great amounts of salt residue. And although the amount of water in the oceans is immense compared to human needs, mere volume does not render the oceans invulnerable. Due regard must be shown for the health of the marine ecosystem. Desalinization is not a substitute for the wise preservation of clean, natural fresh water supplies.

This activity demonstrates the distillation process. It can be used to reinforce the understanding of solutions as physical, rather than chemical, combinations, and to instill concern for wise use of the compound which constitutes most of our bodies.

## Before You Begin

Materials: Two or four students should work on each set-up.

wooden board, such as a large bread board; a sheet of aluminum foil large enough to cover the board; more aluminum foil sufficient for a trough; a rectangular pan of appropriate size, painted in advance with black enamel paint; sea water or salted tap water; two wire hangers or other stiff wire; large, clear plastic bags; a small beaker or measuring cup; scissors; a pebble, small rock, or other support, Student Page.

The activity should be conducted on a sunny day. If there is insufficient time to allow the students to observe the results, they could build the stills at any time and use them on the first sunny day. It is important that there be both enough sun and enough time for sufficient water to recondense. Of course, other things can be going on in the classroom while the water is being distilled.

## Words To Know

distillation, solar energy, salt, saline, desalinization, evaporate, condense, solution

# ACTIVITY

1. Ask the class to name the ways in which they use water. The list will soon become enormous, yet it might not include such uses as the making of everday items (e.g. newspaper: water is needed to make paper from pulp.)

2. Ask if anyone ever uses ocean water for most of these purposes. Why not?

3. Explain that ocean water is a solution of salt in water. So is fresh water, but the ocean is much more salty. (That is, the percentage of salt is higher.) Have students re-define the word solution.

4. Explain that the class will build apparatus to collect fresh water from salty water.

5. Hand out the instruction sheets, answering any questions the class may have about them.

6. Have students construct the stills.

7. Have students set up their stills. About half should be in strong sunlight; the other half should be in shade. If natural shade is not available, you can, of course, create shaded areas. Allow the class to observe their stills for several minutes and record their observations. Then let the stills sit for a time as the distillation process continues.

8. When the allotted time has elapsed let each group record the amount of water collected in its beaker. Let students taste the difference between the fresh water collected and the saltwater in the pan. Average the results for the groups whose set-ups were in the sunlight and those whose stills were shaded.

9. Have students, during discussion or in writing, try to explain the difference between the two averages. The explanation should include a hypothesis about how the still works (based on observations) and about the source of energy for the machine. Leading questions might include:

   a. Where does the water in your beaker come from? (The plastic bags.)

   b. How did it get there? (By condensing from the air.)

   c. How did it get into the air? (By evaporating from the water in the pan.)

   d. Which groups collected more water - those whose setups were in the shade, or those who left their stills in the sun? (Sun)

   e. Why? (The sun's rays provide the energy needed to evaporate the water.)

10. Lead further discussions in as much detail as you wish about water, desalinization, and pollution.

## Related Activities

1. Perform the activity again, using graduated cylinders to carefully measure the amount of salt water placed in the pans. At the end of the activity, measure the amount of water left in the pan. Does the amount of fresh water collected plus the amount of salt water left in the pan equal the amount of water originally placed in the pan? Allow students to construct hypotheses to explain the difference.

2. Let one of the pans stay in the sunlight until the water is completely evaporated. Let students sample the salt residue.

## Resources

G. Tyler Miller, Jr. Living in the Environment; Wadsworth Publishing Company, 1975, Ch. 14, esp. pp. 259-260, and

A. Turk et al, Environmental Science; Saunders, 1974, Ch. 10, esp. pp. 404-405, for general information about the water cycle and desalinization.

## Credit

Directions for building the still come from:

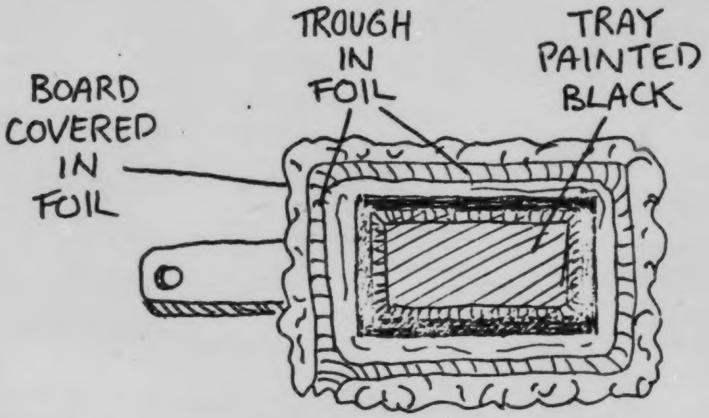
"Build a Water Desalting Model:, Dolphin Log; The Cousteau Society, May/June 1978, page 2.

## Notes To Myself

# STUDENT PAGE

BUILDING A DESALINIZATION MODEL

1. BE SURE YOU HAVE ALL THE THINGS YOU WILL NEED;
   A WOODEN BOARD
   TWO SHEETS OF FOIL
   TWO WIRE HANGERS
   SCISSORS
   A PAN, PAINTED BLACK
   LARGE PLASTIC BAGS
   A MEASURING CUP
   A SMALL ROCK
2. COVER THE WOODEN BOARD WITH A SHEET OF FOIL.
3. SHAPE A TROUGH AROUND THE INSIDE EDGES OF THE BOARD WITH YOUR OTHER SHEET OF ALUMINUM FOIL. BE SURE THAT THERE IS AN OUTLET IN ONE CORNER.
4. PLACE YOUR PAN NEXT TO THE TROUGH ON THE BOARD. WHEN YOU ARE FINISHED, YOUR MODEL SHOULD LOOK SOMETHING LIKE THIS:

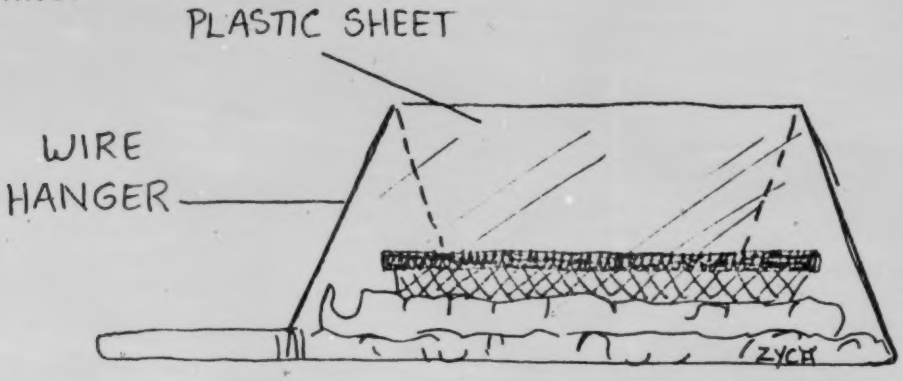


TOP VIEW

5. FILL THE PAN HALFWAY WITH THE SEAWATER OR SALTED TAP WATER YOUR TEACHER WILL GIVE YOU.
6. BEND TWO WIRE HANGERS OR OTHER STIFF WIRE TO MAKE A TRIANGULAR PRISM. MAKE SURE THAT THE SIDES OF THE PRISM FIT ON THE OUTSIDE OF THE BOARD.

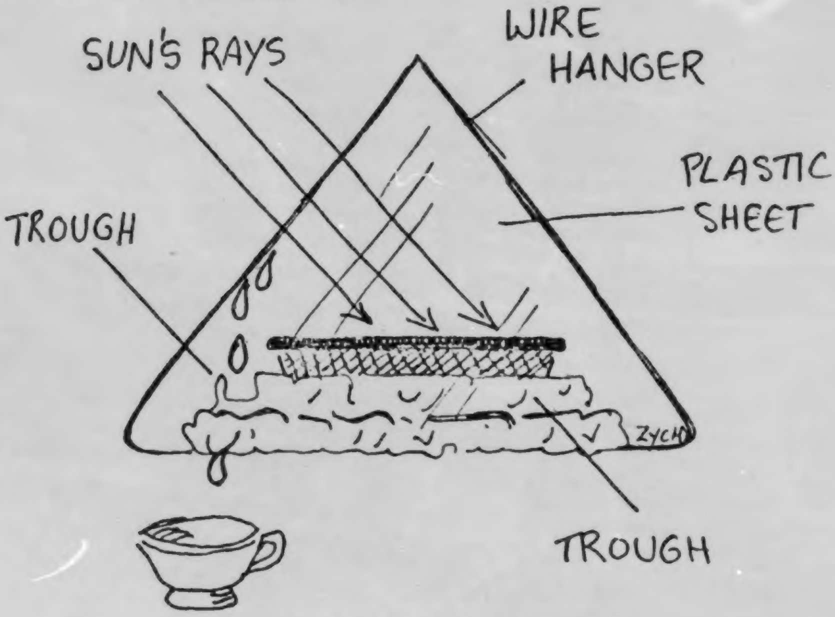
7. Cut your plastic bags into single sheets. Make a see-through tent by using these sheets to cover the outside of the wire prism.

8. Place the plastic wire tent around the outside edge of the trough, like this:


PLASTIC SHEET
WIRE HANGER
ZYCH

SIDE VIEW

9. When you are finished, you will be ready to set your model still to work. Place it in strong sunlight or in the shade, as your teacher directs. Tilt it with a small rock so that the outlet of the trough leans downward. Place a cup at the end of the outlet to collect your fresh water. Here is a view of what your model might look like when it is working:


SUN'S RAYS
WIRE HANGER
PLASTIC SHEET
TROUGH
ZYCH
TROUGH

END VIEW

# A Kayak Through Europe

## Curriculum Topic

Geography (Europe)

## Energy Topic

Energy Uses
Energy Conservation

## Grade Level(s)

5-6

## Site

Classroom, library

## Skills

Map reading and interpreting, measuring

**Credit** Orah Elron in EARTHWATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT, 1978.
Drawing: Cecelia Zych

## Objective

Students will be able to:

1. read and interpret a map,
2. accumulate facts about Central Europe's geography, namely cities and rivers,
3. learn to appreciate energy saving ways of travel.

## To The Teacher

Environmental studies is a global discipline, thus it is necessary to motivate students to read carefully the maps of central and northern Europe and the North Balkan countries. In this activity students will learn to interpret these maps so that they can imagine how these places look, the lifestyle of the people, and describe in detail the places marked on the maps. Students should also have easy access to encyclopedias (Encyclopedia Britannica, if possible) to read further information about the places they "visit" on their trip.

In our age of motorized travel, students will compare long distance travel by waterway. The student will travel on three rivers--the Rhone, the Rhine and from the Inn to Danube. These trips are of different lengths and the teacher should divide the class in groups of unequal size or give the longer trip to those students that are able to handle it.

A description of each trip follows:

1. The Rhone--from Furka Pass (Berner Oberland) to Marseilles in the Mediterranian - 812 km (505 miles) it passes through Vallais valley between two high mountain chains of the Alps--south: Matterhorn 14.713 feet high and approachable from the village of Zermatt (20 miles) from the Rhone Valley. Lausanne - Lake Geneoa - Geneva crosses the border to France: Lyon - Avignon (pope's residence before Rome) to Marseilles - languages: German and French.

2. The Rhine--from St. Gotthard Pass north to Netherlands Atlantic 1320 km (820 miles) - Bodensee (Lake of Constance)(Germany) Schaffhausen (waterfall 24 miles high) - Basel (Switzerland)three country corner, from Basel north the Rhine is the border between France, Alsace and Germany, Black Forest - Strasbourg (Fr.) - Koblenz (Germ.) Bonn (capital) - Cologne - side trip to see the Dom in Aachen (30 km) - Arnhem (Netherlands) - Rotterdam - the Hague; languages are German, French, and Dutch.

3. The Danube--longest river in Europe 2850 km. Our trip starts on the Inn, longest tributary of the Danube, length 510 km and flows into Danube at Passau, Austria (length of the trip 2360 km (1467 miles) Start: Silvaplana (Switzerland) (St. Moritz) on Maldja Pass - Engadin famous beautiful river valley - crosses border to Austria (at Navders) to Innsbruck (Tyrol) crosses border to Germany, Bavaria (side trip to Munich) back to Austria: Passau (into Danube, that is already a wide, fairly quiet river with big ships) - Linz - Melk (Wachau, beautiful hill with vineyards) - Vienna - to Hungarian border - Budapest(Yugoslaic border) Belgrade - from there the Danube serves as border between Romania in the north, Bulgaria in south - to Black Sea delta (Galati and Braila); languages: German, Hungarian, Romanian (Yogoslavic, Bulgarian)

The trip along the Danube has been described by a group of six USA s students in the National Geographic Magazine, July, 1965.

The trip along the Rhine is described in the National Geographic Magazine, April, 1967.

Both with beautiful photographs and many details. There was also a TV program "Yankee Sails Across Europe" on April 8, 1967.

(Information available through National Geographic Society, Washington DC 20036)

## Before You Begin

Materials: atlas to each pair of student, encyclopedia and geographic information about Switzerland, Germany, France, Austria, Netherlands, Hungary, Romania.

Students should have string to measure distances on the map and be familiar with the scales of maps, and the metric equivalents for length and height measurements.

It might be helpful to have pictures and traveling information (often free at travel agencies) about the above countries.

# ACTIVITY

1. Introduce the activity through short story (told to the class) On your birthday you received an inflatable kayak as a present, something you had been dreaming about thr a long time. These boats are easy to carry. With some instruction one person can ride in the kayak even in very white, rough water. You also saved some money through the school year by doing occasional jobs, and thus you can fulfill your big wish to travel. Last year in your class, a foreign student from Switzerland invited you to his family's home in Interlaken, Switzerland. The friend's parents pick you up at Zurich's airport and bring you to their home near the snow covered peaks of the Alps. You are able to spend a wonderful week at their house, but you wish very much to do some traveling of your own, having taken with you the new kayak and your sleeping bag.

2. Students can then divide into three groups to choose one of the rivers: a) the Rhone, b) the Rhine, c) the Danube on which to travel.

3. With the help of an atlas (for each group of students) and geographic information about the relevant areas, students will describe their trip on one of the three large rivers. Each group can further divide the trip on the river among the student in the group so that they can, as a group, describe the entire length of the trip.

4. Questions for the students to consider:

   a. How long is your trip from start to the end?

   b. How much money would you spend on gas if you traveled this distance by car? Investigate European gas prices per liter.

   c. How many miles (or km) do you intend to travel each day?

   d. How many days will you be on the river? (Trip on Danube described in National Geographic Magazine, 1965 lasted six weeks.)

   d. How far from your friend's house will you have to travel to the starting point of your voyage? (you get to this place by car from your friend's house in Interlaken).

   e. List starting point and (at least) five interesting places that you pass on your way. Where does the river reach the sea--which ocean? What is the name of the harbor?

   f. Which countries do you pass? What language do they speak? What currency do they use? Can you estimate how much money you would spend on this trip?

   g. You have enough money to travel 100 miles by railroad or bus on a trip away from the river. What additional places close to the river will you visit on your way?

5. After having done their individual work, each group should combine all their information for a description of the whole journey and places of interest visited.

## Related Activities

1. Try to write a more detailed travel report including pictures, adventures on the way, information about places you visited.

2. Collect important phrases in the languages you needed on your journey - "Greetings", "Where do we find..?", "How far to...?" "What is the price of...?", "Thank you", "Please"

## Resources

National Geographic, July 1965, April 1967.

## Notes To Myself

Credit: drawing-Cecelia Zych

# "How Can I Get There?"

### Curriculum Topic

Citizenship and Civics
Transportation

### Energy Topic

Energy Uses
Energy Conservation
Energy and Economics

### Grade Level(s)

5-6

### Site

Home, Classroom

### Skills

Obtaining and organizing information, using information for a purpose

**Credit** Orah Elron in EARTH-WATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT, 1978.

## Objective

The student will be able to:

1. gather and organize data,
2. generalize from data that forms of transportation other then the car are more energy efficient.

## To The Teacher

One problem of energy use in our society is transportation. Most of American life is based on the private car. It is needed to reach a place of work, a school, recreation areas, etc. Although children often walk to school or take the school bus, they understand their dependence upon the auto. In this activity children should research the public transportation available in their home area. They should consider the insufficiency of public transportation and understand the need for better ways to "travel" in the future. They also will compare the time restraints, the costs and other limits of public transportation as compared to the private car.

## Before You Begin

Obtain detailed maps of your town and/or area for each student and also the telephone numbers of any public transportation agency (town hall would be able to give information and the bus company - Connecticut Transit in the New Haven area). You might wish to have the available information mailed to you in advance or let the children individually write for it.

## Words To Know

public transportation, department of transportation, time table

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# ACTIVITY

1. Ask students to mark their homes on the map of the city (town, area) which you supply. It might be advisable to work in small groups of 4 so that 4 students can spread a map on a desk together.

2. Students will then mark a place of interest on the map which is:

   a. in center of town
   b. at the other end of town
   c. a distance of 10-15 miles away from their home.

3. Their task is to travel from their home to these three places without the use of a private car. They may use bus, train, bicycle or walk. Students will have to determine the route to travel, the time necessary and the expense.

4. Students can then measure on the town map the distance between several important places (with ruler and string) and figure how many miles they would have to travel by bus as compared to a car. How long will it take to reach their goal by bus as compared to a car?

5. Students should compare the expenses of car travel to a bus ticket - (It costs approximately 17¢ per mile to drive a car).

## Related Activities

1. Students can transfer all available means of public transportation with colored crayon into town map and note the many places that are not reachable by public transportation.

2. Students might compare the situation in a small town with a metropolis (e.g. New York, Boston, San Francisco) that have most efficient public transportation systems.

3. Students can obtain information (from travel agencies) about public transportation service in other countries - railroads, buses.

## Notes To Myself

# Hot Water & Energy Consumption

**Curriculum Topic**

Economics
Lifestyles

**Energy Topic**

Energy Uses
Energy and Economics
Energy Conservation

**Grade Level(s)**

6

**Site**

Classroom, home

**Skills**

Interpreting data, locating and obtaining information, brainstorming, computing

**Credit** Ed Lisk in EARTHWATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT, 1978.

## Objective

The student will be able to calculate the quantity and cost of the hot water used in the home.

## To The Teacher

After space heating and cooling, water heating is the largest consumer of energy in the home. As much as 15% of residential energy is used for water heating. This accounts for 3% of all energy used in the United States.

There are many ways hot water can be conserved:

a) Insulate hot water pipes and hot water tank.

b) Don't overheat water. 125 degrees F is adequate for dishwashing. (Over this temperature wastes 3% of total energy for every 10 degrees F)

c) Repair dripping faucets.

d) Take showers which generally use one-half the amount of water, compared with baths.

## Before You Begin

Duplicate and distribute student worksheet. Students will need pencils. Use a calculator if available.

## Words To Know

BTU, kilowatt-hour

# STUDENT PAGE

## STUDENT WORKSHEET

GIVEN:

1. THE AVERAGE AMERICAN FAMILY USES 20 GALLONS OF HOT WATER PER PERSON, PER DAY.
2. IT REQUIRES APPROXIMATELY 800 BTU'S PER GALLON TO HEAT AND MAINTAIN WATER AT 140 DEGREES F.
3. THE COST OF 100,000 BTU'S OF ENERGY IS:
   OIL - 100,000 BTU'S (1 GAL.) = $.50
   NATURAL GAS - 100,000 BTU'S (120 CUBIC FEET) = $.40
   ELECTRICITY - 100,000 BTU'S (30 KILOWATT-HOURS) = $1.35

QUESTIONS:

1. HOW MANY PERSONS ARE IN YOUR FAMILY?____________________
2. HOW MANY GALLONS OF HOT WATER DOES YOUR FAMILY USE? PER DAY__________
   PER WEEK______________ PER MONTH ______________ PER YEAR__________
3. WHAT ARE THE NUMBER OF BTU'S NECESSARY FOR YOUR ENERGY NEEDS?
   PER DAY ______________ PER WEEK ______________ PER MONTH ________
   PER YEAR ______________.
4. WHAT FUEL DOES YOUR HOME USE FOR HEATING HOT WATER? ______________
5. CALCULATE THE COST OF HOT WATER IN YOUR HOME FOR YOUR FAMILY.
   PER DAY__________ PER WEEK ______________ PER MONTH ______________
   PER YEAR __________.
6. FIND ANOTHER MEMBER OF THE CLASS WHOSE FAMILY USES THE SAME NUMBER OF BTU'S BUT USES A DIFFERENT ENERGY SOURCE. COMPARE YOUR RESULTS WITH HIS/HERS. ______________________________
   ______________________________
   ______________________________
7. LIST 5 WAYS YOU CAN REDUCE HOT WATER ENERGY USAGE IN YOUR HOME.
   A. ______________________ D. ______________________
   B. ______________________ E. ______________________
   C. ______________________.
8. ESTIMATE THE PERCENTAGE ENERGY-SAVINGS IF THESE 5 WAYS WERE IMPLEMENTE FOR A YEAR. ______________________________

# ACTIVITY

1. Begin the investigation with a brainstorming session during which students list all ways that hot water is used in the home.

2. When the list from step 1 is sufficiently exhaustive, prioritize the hot water used based on the class estimation of the quantity of hot water needed for each task.

3. Have each student complete the calculations on the "Hot Water Usage" worksheet.

4. Question seven asks students to consider ways of cutting down hot water energy use in their homes. Here students may want to initiate research outside of the classroom or to brainstorm as a class a list of ways to eliminate waste in the production and use of hot water in the home.

## Related Activities

1. Encourage students to implement energy saving techniques into their homes with parental cooperation, and then to look for savings in the monthly utility bill.

2. As a class, analyze hot water energy consumption for the entire school based on a random sample of the school population based on the worksheet.

3. Let individual students investigate alternative energy sources and their potential for meeting hot water needs in Connecticut.

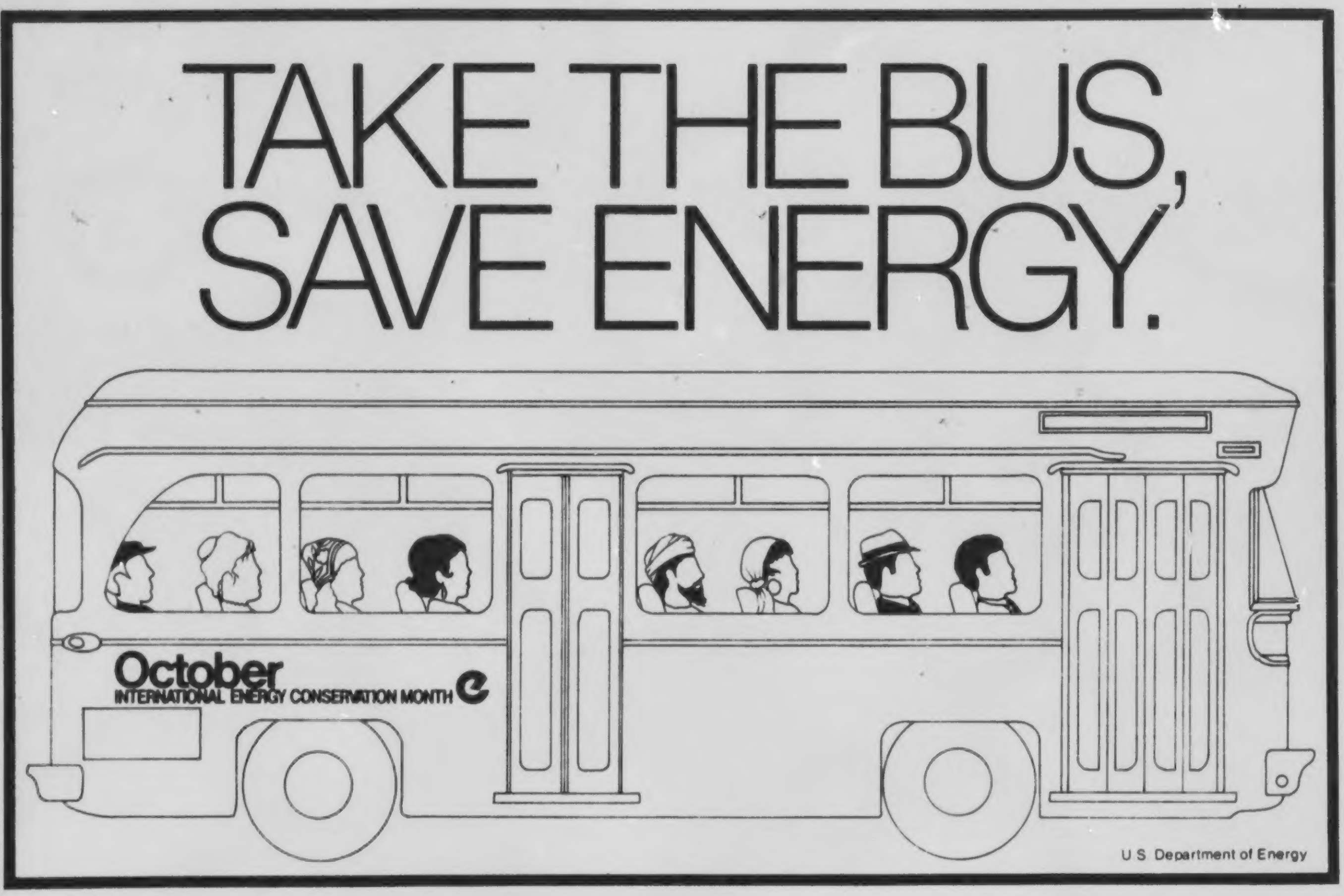
## Resources

Solar Water Heating, Northeast Solar Energy Center, 70 Memorial Drive, Cambridge, Massachusetts 02142

In The Bark Or Up The Chimney, Office of Policy and Management, Energy Division, 80 Washington Street, Hartford, Connecticut 06115

## Notes To Myself

## ENERGY CONSERVATION


TAKE THE BUS,
SAVE ENERGY.
October
INTERNATIONAL ENERGY CONSERVATION MONTH
U.S. Department of Energy

# ENERGY - CONSERVATION

ACTIVITY TITLE PAGE NUMBER

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HOW MUCH ENERGY DO YOU USE?..........................152

# AN ENERGY CONSERVATION ETHIC

"At the present time, American society seems to emphasize materialism, and behind materialism stands the "Work Ethic"--that citizens should work as hard as possible, produce as much as possible, be as successful as possible, and buy as much comfort as possible. These attitudes have led to tremendous consumption of energy resources.

During the era of cheap energy prices and rapidly expanding national economy, our society became a "convenience" or "disposable" society, where things were made to be discarded and products were designed for early obsolescence. In the past, ever-cheaper energy was used both to increase worker productivity and to provide an outlet for increased disposable income (through increased travel, air conditioning, and so on). Consequently, our society has become increasingly energy intensive.

If citizens are to slow the exponential energy demand growth rate which may limit options available to future generations, they must modify their "Work Ethic" with a new ethic--a "Conservation Ethic."

Twenty years ago, Leopold, in his book Sand County Almanac, wrote:

> An ethic, ecologically, is a limitation of freedom of action in the struggle for existence. As an ethic, philosophically, it is a differentiation of social from anti-social conduct.

The same might be said today about a Conservation Ethic. Such an ethic can carry us beyond cost-saving responses to changes in our behavior--our mode of living. Teachers must make clear to their students that this new ethic is based on a realistic comprehension that so many of the raw materials on which current living standards rely will be expended in the foreseeable future. At the present time, such a basis has a quite limited appeal to a country that is, in terms of energy, spoiled, self-indulgent, and extravagant; the ethic is unpalatable. But for the sake of future generations, teachers must awaken in themselves and their students a moral sense of waste and greed that will lead to the acceptance of the Conservation Ethic.

Some observers claim that conservation measures will alter not only our "freedom" to consume but also the "comfort" we derive from consumption. As the Scientists' Statement on Energy Policy says, "One man's conservation may be another man's loss of job. Conservation, the first time around, can trim off the fat, but the second time will cut deeply." This statement seems to reflect the muddy thinking and confusion between conservation and curtailment.

Conservation is a rational act to achieve and maintain an amenable lifestyle at minimum price. Such an achievement cuts waste; for example, wasteful use of heating oil can be decreased by adding more insulation to a home. In the long run, money will be saved. Also, conservation measures increase efficiency; for example, you can buy an air conditioner that is more energy efficient than another air conditioner of comparable size and quality. The air conditioner may be more expensive to buy than the less efficient model, but in the long run more dollars will be saved in operating the more efficient model than the difference in cost between the high cost model and the lost cost model.

It is true that conservation can affect employment, but it is not necessarily true that conservation cut employment. For example, decreasing the production of disposable bottles leads to a decrease in the number of people required to produce the disposable bottles, a decrease in the number of people needed to pick them up, and a decrease in the number of people needed for land-filling the bottles. But on the other hand, returnable bottles must be returned to the factory and washed; actually, returnable bottles require more net jobs than disposable "one-way" bottles. Another example: jobs lost in the oil or electrical industry due to a lower consumption of heating oil or electricity are more than off-set by jobs installing insulation.

Because the Conservation Ethic can seem unpalatable, teachers must make a major effort to help students understand the new ethic and to foster in them an awareness of the difference between essential needs and nonessential desires. The individual that possesses a Conservation Ethic gives great thought to the following questions before buying any product, whether it be an air conditioner, heat pump, can opener, or synthetic fabric:

1. Do I really need it to be happy?
2. Will buying it help promote a more materialistic lifestyle?
3. Is it the cheapest, yet most effective in terms of total cost?
4. What resources are in it?
5. Are the resources scarce or nonrenewable?
6. From what countries do the resources come?
7. Are there other resources which could be used to make it?
8. What could be used as a substitute or alternative?
9. Did its production result in significant environmental/ecological damage?
10. Will its use result in significant environmental/ecological damage?
11. How long will it last and can it be recycled?
12. Is it efficient and safe?

Clearly, an "Energy Conservation Ethic" is a conscience in the individual that reminds him to think in terms of wise and efficient use of resources when developing, buying, or consuming them. It reminds him about his "stewardship" responsibility to maintain an ecological balance for survival, that the natural environment is not limitless in its capacity to assimilate waste and abuses.

The following "Energy Conservation Creed" is a possible expression of the energy conservation ethic:

> I pledge that I will learn to participate automatically in all those conservation activities which have no apparent disadvantages to myself

> and which require minimal energy on my part. I further pledge that although certain conservation activities may have minor personal disadvantages, I will volunteer to participate in them. And in the event that these activities are not sufficient, I will tolerate those activities which may produce serious disruptions in my lifestyle. I pledge all this in the interest of future generations.

It is hoped that teachers will instill this creed in themselves and in their students and that students will urge their parents to participate in conservation activities. Educators can help the Energy Conservation Ethic become a way of life; educators can help create a more efficient,durable society that cares about the energy inheritance it will bequeath to future generations."[1]

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[1] *Energy Conservation in the Home: An Energy Education/Conservation Curriculum Guide for Home Economics Teachers*, University of Tennessee Environment Center and College of Home Economics, 1977.

# Draft-o-Meter

## Curriculum Topic

Meteorology

## Energy Topic

Energy Conservation
Energy and Economics

## Grade Level(s)

K-3

## Site

Classroom, schoolgrounds, home

## Skills

Constructing models
Gathering information
Using information for a purpose

**Credit** "Conservation: Science Activities in Energy," U.S. Dept. of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, TN, 1977. Adapted by Carla McGeeney in EARTHWATCH Vol. I, EEC, ACES, New Haven, CT 1978.

## Objective

The students will be able to:

1. Determine when an air draft is present in a room.
2. Describe steps in the construction of a draft-o-meter.
3. Recognize the relation between a draft and energy loss.

## To The Teacher

An anthropological definition of the primary function of a home is its ability to provide a comfort zone for the inhabitants. In this way, it can be considered to be a shell with a roof, sides and foundation. The primary use of energy in the home is for heating and cooling, and considerable energy savings can be achieved by improving the "shell". A savings of 20% to 40% of energy consumption in an average home could easily be accomplished by improving insulation, caulking, weatherstripping and/or storm windows.

Using the draft-o-meter, the students should be able to determine and describe features of the construction of their school "shell" and of their home "shells." They will be able to detect drafts, and from this data, infer information to describe the architectural surroundings in which they live and study.

## Before You Begin

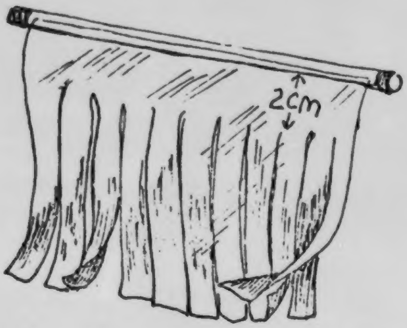
Forced air furnaces must be off to use a draft-o-meter.

MATERIALS: for each student: 1 kleenex, tape, stick or dowel (12 cm in length) or a pencil

# ACTIVITY

1. Instruct students to tape the kleenex to the stick, lengthwise.

2. Cut the kleenex into strips (see picture) to within 2 cm of the dowel.



3. The draft-o-meter is now ready to use. Assign students to different areas of the school where they can test windows and doors. At each site, students should record the location and amount of draft: whether there is little waving of the strips or a lot of waving. (A demonstratio of the differences would be helpful.)

4. At the conclusion of the search:

a) Have students write a letter to the school principal in which they will describe the results of their findings.

b) Lead a discussion about drafts and how they contribute to energy waste.

## Related Activities

Let students take their draft-o-meters home to test their "shells" there and to discuss the results with their parents.

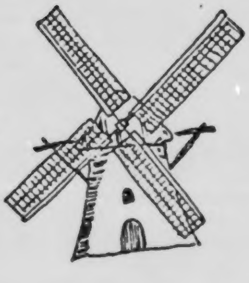
## Credit

"Conservation: Science Activities in Energy," 1977 (can be purchased from U.S. Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830)

## Words To Know

draft, insulation, caulking, weatherstripping

## Notes To Myself



# ELECTRICITY: WHO NEEDS IT?

## Curriculum Topic

Electrical Energy

## Energy Topic

Energy Conservation

## Grade Level(s)

3-6

## Site

Classroom

## Skills

Recognizing problems
Generating alternate solutions

**Credit** Your Energy World, Unit Three, "Energy Use in Homes and Stores", U.S. Department of Energy, Technical Information Center, Oakridge, Tennessee 37830

## Objective

The student will able to:

1. recognize wasteful and conserving practices,
2. suggest alternatives to the use of electrical appliances.

## To The Teacher

America, with six percent of the world's population, uses more than one-third of the world's supply of energy, energy that comes primarily from dwindling supplies of petroleum. Only 18 percent of our energy needs are met by coal, four percent by hydropower, and three percent by nuclear and other sources of energy. Even if development of other kinds of energy such as solar, nuclear, windpower, and geothermal move ahead at top speed, it will be another 20 to 30 years before they will provide a significant portion of our energy supply. So we continue to be dependent on supplies of expensive oil, which could be seriously depleted by the next century. Our only hope to stretch this precious resource and to buy time to develop other energy sources is conservation.

Commercial and residential buildings use one-third of the total energy consumed in this country. More than one-half of that is used for heating and air conditioning, a third to operate other equipment and appliances in both offices and homes, and the rest for lighting--indoors and outdoors. These are things that all of us use every day, and the way we use them can make a difference.

We cannot turn the clock back a hundred years--even if we wanted to. Our lives have become complicated, busy, and crowded. But we can modify our lifestyle somewhat to conserve our energy resources, and in doing so we may discover some benefits for ourselves and our families.

## Before You Begin

Duplicate copies of Student Page.

## Words To Know

Electricity

## Notes To Myself

# ACTIVITY

Part A

Using the game format of a spelldown, play "Waste and Save." Divide the class into two teams and ask each team, in turn, the following questions. They are to answer "waste" or "save" to each situation.

1. Cook extra food each time you use the oven. save
2. Wash dishes in the dishwasher after every meal or snack. waste
3. Place the refrigerator next to the stove or by the radiator. waste
4. Avoid opening the refrigerator door frequently. save
5. Remove lint from washer and dryer filter every time you use them. save
6. Dry as many clothes in each dryer load as you can push into it. waste
7. Take showers instead of baths. save
8. Place floor or table lamps in a corner of the room instead of against one wall. save (To the teacher: Two walls reflect more light than one does.)
9. Paint walls and ceiling a dark color. waste
10. Dust bulbs and light fixtures and lampshades regularly. save
11. Turn dishwasher off right after final rinse and air-dry dishes. save
12. Wash clothes in warm or cold water. save
13. Watch black and white TV instead of color whenever possible. save
14. Turn lights off when they are not needed, even for a few seconds. save
15. Use flat-bottom pans and cover them to speed cooking time. save
16. Use hand tools, hand mowers and clippers whenever possible. save
17. Iron everything you wear. waste
18. Buy products that are durable and will last a long time. save
19. Buy products made from recycled materials. save
20. Buy frozen and processed food and food wrapped in plastic and aluminum foil. waste

Part B

1. Pass out the activity sheet and read through the opening paragraph with them. The activity suggests that electricity has been cut off from homes and stores for an indefinite period of time. Assuming that there is an adequate supply of food in the house and that everyone in the family is in good health, the children are asked to imagine how they and their families would perform certain tasks without electricity. They will write their answer to each problem in the space provided.

2. Once they have written their answers, encourage children to discuss what they have written. They might even want to pantomime or dramatize the situations they evolve. Follow the discussion by asking if they can think of any appliances they use at home that they could do without.

## Related Activities

1. Children might find it fun to take the activity sheet home with them and have their parents imagine the same situations. They can then compare their answers with those given by their parents.

# STUDENT PAGE

IMAGINE A DAY THAT STARTS SOMETHING LIKE THIS: YOU ROLL OVER IN BED, OPEN YOUR EYES, AND DISCOVER THAT THE MORNING SEEMS MUCH BRIGHTER THAN IT USUALLY DOES AT THE START OF YOUR DAY. YOU CHECK YOUR ALARM CLOCK, BUT THAT TURNS OUT TO BE NO HELP AT ALL. IT STOPPED AT 12:05. YOU KNOW THAT'S NOT RIGHT! YOU JUMP OUT OF BED AND RUN INTO THE KITCHEN. THE BATTERY-OPERATED CLOCK TELLS YOU THAT YOU ONLY HAVE 15 MINUTES TO GET TO SCHOOL--JUST ENOUGH TIME FOR A QUICK SLICE OF TOAST AND A CUP OF HOT INSTANT CHOCOLATE.

BEFORE YOU GO BACK TO YOUR ROOM TO GET DRESSED, YOU POP A SLICE OF BREAD INTO THE TOASTER AND TURN ON THE ELECTRIC RANGE TO BOIL SOME WATER. WHEN YOU GET BACK TO THE KITCHEN, YOU FIND THAT EVERYTHING IS EXACTLY THE WAY YOU LEFT IT--THE BREAD IS UNTOASTED AND THE WATER IS COLD.

AND THAT'S ONLY THE BEGINNING!

SUPPOSE THE ELECTRICITY IN YOUR COMMUNITY HAS BEEN SHUT OFF UNTIL FURTHER NOTICE. AND SUPPOSE EVERYONE IN YOUR FAMILY IS IN GOOD HEALTH AND THERE IS PLENTY OF FOOD IN THE HOUSE. YOU SHOULDN'T HAVE ANY PROBLEMS, RIGHT? WELL, WITHOUT ELECTRICITY, HOW WOULD YOU AND YOUR FAMILY:

1. COOK YOUR FOOD?________________________________________
2. WASH THE DISHES?_______________________________________
3. OPEN A CAN?___________________________________________
4. MAKE TOAST?___________________________________________
5. BAKE A CAKE?__________________________________________
6. STORE FOOD IN SUMMER?___________________________________
7. STORE FOOD IN WINTER?___________________________________
8. WASH THE CLOTHES?______________________________________
9. KEEP WARM IN WINTER?____________________________________
10. HAVE LIGHT IN YOUR HOUSE?________________________________
11. ENTERTAIN YOURSELVES?___________________________________
12. GET TO THE 6TH FLOOR OF A BUILDING?__________________________
13. GET A WEATHER REPORT?___________________________________
14. COMMUNICATE WITH A FRIEND ACROSS TOWN?________________________

# Conservation Heroes

## Curriculum Topic
Career Awareness
U.S. History

## Energy Topic
Energy Conservation

## Grade Level(s)
3-6

## Site
Classroom

## Skills
Locating and obtaining information, using information for a purpose.

**Credit** Cyndi Walsh in EARTH-WATCH, Vol. I, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT, 1978.

## Objective
The student will be able to:

1. identify conservation heroes of the past and present.

## To The Teacher
Surrounded by abundance, Americans began only slowly to realize the need for conservation. To most people, limiting the use of resources was contrary to the American way of life. However, concern for conservation began with the protests of a few scientists and writers. It was these protestors who realized what could happen in areas where population, urbanization, and industry were expanding without concern for environmental impact.

During the rise of conservation as a national policy in the United States, concerned individuals led the way by awakening the American people to the need for care for the natural environment. Through individuals, who's writings and political efforts provoked and fostered effective governmental policy regarding the environment, Americans become interested in conservation. All of the major problems, issues and conflicts in the development of an enlightened attitude toward the land can be traced through these "conservation heroes."

## Before You Begin

Materials: a variety of biographical materials, encyclopedias, National Geographic Index, conservation related periodicals, Audubon Magazine index.

## Words To Know

conservation, hero, career

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# ACTIVITY

1. Ask your students to select a conservation hero (heroine) from the suggested list (attached) or find one of their own.

2. Assign research time for information collecting about the chosen individual or group. Librarian may be asked to assist in aiding the student's research. The students may be inclined to write letters to recommended groups and organizations for further information on particular individuals.

3. After information is collected, ask students to prepare a conservation Hall of Fame. Each exhibit should include some of the follow following:

   a. Picture, drawing or photograph of the hero.

   b. Time line of events - individual's accomplishments and failures.

   c. An article of clothing the person might have worn.

   d. An object that might have been treasured by this person.

   e. A picture or diagram that tells about their greatest accomplishment.

   f. Information card with an explanation of exhibit.

4. Ask students to make a small museum display on a board or in a box.

5. Set up Hall of Fame and allow time for presentation of chosen heroes.

## Related Activities

1. Research the following clubs and organizations and prepare an exhibit of them. Write letters to determine their function and founders:

League of Women Voters of the U.S., 1730 M. Street, NW Washington, DC

National Audubon Society, 1522 K Street, NW, Washington, DC

National Wildlife Federation, 1412-16th Street, NW Washington, DC

Sierra Club, 1050 Mills Tower, San Francisco

National Assoc. of Soil and Water Conservation District
Vermont Avenue, NW, Washington, DC 20005

The Izaak Walton League of America, 2326 Wauekegan Road
Glenville, IL 60025

Garden Club of America, 598 Madison Avenue, NY 10022

The Conservation Foundation, 1250 Connecticut Avenue, NW
Washington, DC

The Urban Coalition, 2100 W Street, Washington, DC

The E. S. Environmental Protection Agency, Washington, DC 20037

2. Spend time interviewing a local environmental protector by letter, phone, in person. Find out about this person's life story, past experience, training ambitions, values. Write an editorial about this person and include in the environmental hall of fame.

3. Write an autobiography of you - an average American student who has decided to become a National hero as an environmental protector. In your life story include the major accomplishments that you will achieve in your lifetime and what national heroes have influenced you. (From: Environmental Law, Computer Based Resource Unit, NY State University)

## Resources

Forte, I. and J. Mackenzie, Kids' Stuff, Incentive Publishers, 1976.

State University College at Buffalo, NY, Computer Based Resource Unit, Environmental Law: Obj. #33.

## Notes To Myself

# STUDENT PAGE

## SUGGESTED LIST OF CONSERVATION HEROES

PETE SEEGER - MUSICAN, PROTEST SONG WRITER
GREEN PEACE - PORTEST GROUP ON WHALE KILLING
LADY BIRD JOHNSON - FORMER FIRST LADY OF THE UNITED STATES
JOHN MUIR - FOUNDER OF THE SIERRA CLUB
SENATOR GEORGE MCGOVERN - POWERFUL ADVOCATE OF ENVIRONMENTAL CONCERNS
JOSEPH SAS'S - PROFESSOR, AUTHOR OF THE BOOK DEFENDING THE ENVIRONMENT: A STRATEGY FOR CITIZEN ACTION, ALFRED A. KNOPF, 1971
JACQUE COUSTEAU - FRENCH NATURALIST
GIFFORD PICHARD
FREDRIC LAW OLSMESTAD
HENRY D. THOREAU - AUTHOR OF WALDEN'S POND
ERNEST HEMMINGWAY
THOMAS JEFFERSON
RUSSEL TRAIN
PRESIDENT TEDDY ROOSEVELT
TOM MCCALL - OREGON'S GOVERNOR, FORMER JOURNALIST, TV NEWSCASTER, DEFENDER OF ENVIRONMENTAL QUALITY - MAKING A MODEL STATE EXCELLENT ARTICLE IN AUDUBON MAGAZINE, SEPT. 1973 PP PP. 130-132.
JOHN BURROUGHS
BALANGER

# Snowed Under

## Curriculum Topic

Earth Science

## Energy Topic

Energy Conservation
Energy and the Environment

## Grade Level(s)

4-6

## Site

Outdoor snow-covered area

## Skills

Collecting, compiling, and graphing data; measuring, observing

## Credit

"Snow Temperatures" Outdoor Classroom Environmental Education Guide, U.S. Fish and Wildlife Service, 1975. Adapted by Pat Krukowski in EARTHWATCH Vol. II, Environmental Education Center, ACES, New Haven CT, 1978.

## Objective

Students will:

1. gather data which illustrate the insulating effects of snow
2. plot graphs to show the effect on snow temperatures of different variables
3. investigate relationships between the survival of small animals and snow depth and temperature
4. design and construct snow caves to be heated

## To The Teacher

Snow performs a very important role in protecting plants and animals from freezing. Because snow is a poor conductor of heat, it has the capacity to insulate the soil underneath it. Soil temperature will be higher, therefore, under a cover of snow than it would be without it. Temperatures under the snow at the soil surface have been measured to be 15-32 degrees F warmer than soil without snow protection. The protection afforded by snow has enabled small mammals to survive in winter in regions where, without its warming influence, these animals would perish. This, in turn, ensures the survival of larger, carnivorous animals such as arctic fox, ermine, weasel and sable who feed on the smaller animals.

Humans also take advantage of the insulating effects of snow. The classic example is the Eskimo igloo which, when properly constructed, can be quite comfortable even when outside temperatures are well below freezing. Campers build snow caves to insulate themselves from freezing temperatures. Pockets of air in the compacted snow provide good insulation. The inside of the caves can be tiered, the highest tier used for sleeping. Colder denser air will fall away toward the lower levels.

## Before You Begin

Each student team (2-3 students) will need the following equipment:

thermometer - accurate to one degree F or .5 degree C. (Tie on a long, colored yarn to prevent loss in snow); one-half inch diameter candle and matches; metersticks or yardsticks; copies of Student Page (data sheet); graphing paper, question sheet.

Select a site large enough to accommodate teams of students working along a line with 10-20 foot spaces between teams. It should include sheltered areas (woods), exposed areas (fields), and, if possible, a hillside with both north and south faces. Select your stations beforehand and mark them with numbered sticks.

You will need to introduce the term "insulator" and instruct students on the correct way to take temperatures. Warm hands should not hold the thermometer. It is best to set the thermometer down and wait for the indicator to stop moving before a reading is taken. Warmth from the sun can give a false reading, so measure with the thermometer in a shadow. A wet thermometer will be cooled by evaporation and give a false reading. When taking cave temperatures, thermometers should be shaded from the candle flame so as not to measure radiant heat.

## Words To Know

insulator

# ACTIVITY

1. Proceed with class to selected sites and assign to each team one specific area.

2. Direct students to follow Data Sheet, recording temperatures from different snow depths as indicated. (The illustration on the Data Sheet will help them.)

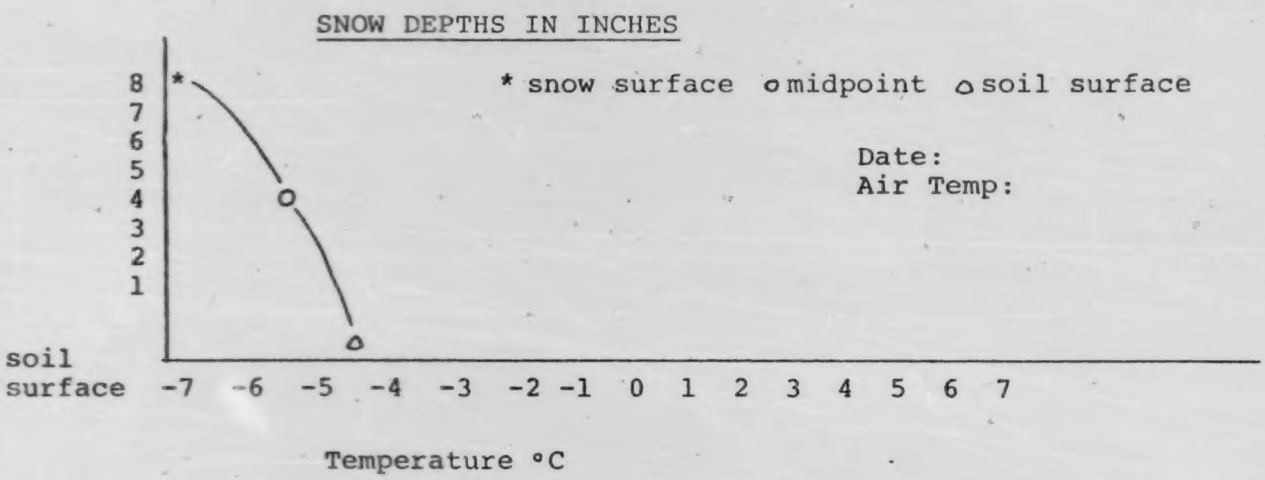
3. On Data Sheet: Instruct each team to make a record of every evidence of small animal activity that can be found within the assigned area. (tracks, bits of fur, tunnels, carcasses or parts of carcasses)

4. Conduct a contest to see which team can design a snow cave that can be heated to the highest temperature. Two limitations on the design are that the heated part of the caves cannot be less than 1 cubic foot in size and that only candles can be used for heating.

5. Return to the classroom to discuss the snow-cave designs. Try to have students consider what design elements caused high or low temperatures.

6. Have each team collect information from all other teams to complete Data Sheet for all stations.

7. On graph paper have each team record own findings as in the sample below:



More appropriate depth and temperature intervals can be selected. (On an unusually warm day, the slant might go in the opposite direction).

8. Have students answer question sheet.

## Related Activities

Another investigation requires that students find a location near the school where daily temperatures of undisturbed snow can be taken for a sequence of several days. They then study the fluctuation of snow and soil temperatures in comparison to the daily fluctuation in air temperature.

## Resources

"Snow Temperatures" "*Outdoor Classroom Environmental Education Guide*," U.S. Fish and Wildlife Service, #5, 1975

## Notes To Myself

# Data Sheet SIDE ONE

Outdoor Classroom Guide Number

## Snow Temperatures

Names ______________________________

______________________________

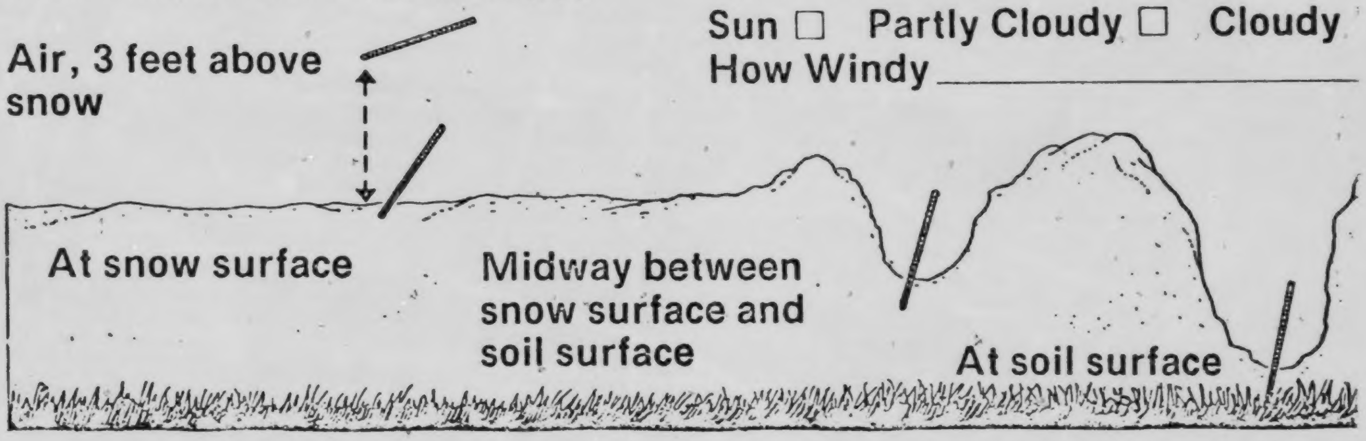
______________________________

Station Number ______ Date ______

Sun ☐ Partly Cloudy ☐ Cloudy

How Windy ______________________________

TEMPERATURE READINGS:


Air, 3 feet above snow
At snow surface
Midway between snow surface and soil surface
At soil surface

| Station | Description of Site | Air Temp.3 ft.above snow surface | Temp. at snow surface | Temp. mid-way | Temp. at soil sur-face | any evidence of animal activity? |
|---|---|---|---|---|---|---|
| | | | | | | |

# STUDENT PAGE

Question Sheet:

1. Why were stations in different types of environments (wooded areas, open fields, sides of hills) chosen?

2. Refer to your Data Sheet. At which depth (air temperature, snow surface, midway to soil, soil surface) did the temperature vary the most from station to station? Can you determine why?

3. At which station did team members find the greatest temperature change among those 4 depths? Where was that station located? Why the variation there?

4. Did you find any relationship between the presence of animals and snow depth? Location of station?

5. Look at your graph and explain the direction of the line's slant.

6. Are there people who use snow as insulation in building their homes?

7. How do most Americans insulate their homes?

8. Would you say, after these investigations, that snow is a good insulator?

# An Energy Ethic

**Curriculum Topic**

Electricity

**Grade Level(s)**

4-6

**Site**

Classroom

**Skills**

Valuing, critical thinking

**Energy Topic**

Energy Sources
Energy Uses
Energy Conservation

**Credit** "An Energy Education/ Conservation Curriculum Guide for Home Economics Teachers," Univ. of Tennessee Envir. Ctr. and College of Home Economics, 1977. Adapted by Ed Lisk in EARTHWATCH, Vol. II, ACES, New Haven, CT 1978.

## Objective

The student will be able to:

1. evaluate his/her dependency upon electricity.

## To The Teacher

Everything we do uses energy in some form. Large amounts of our energy consumption is indirect. Encourage the students to look for the "hidden" or indirect use of energy that accompanies all our products and activities.

This is an activity in values clarification. The major aim of the values clarification approach is to help students identify their own personal values relative to specific issues or problems.

## Before You Begin

Preparation: Duplicate worksheet for class distribution.

## Words To Know

priorities, energy intensive, conservation

# ACTIVITY

1. Distribute worksheet to class

## Related Activities

1. Discuss the relationship between monetary savings and energy conservation.
2. Develop an Energy Alternatives bulletin board.
3. Keep a record of personal energy use per day, week, month.
4. Have student spend a day "without using energy".

## Resources

Garvey, G., Energy, Ecology, Economy, W.W. Norton & Co., Inc., 1972.

Home Energy Savers Workbook, Dept. of Planning and Energy Policy, Hartford.

Turk, A., J. Turk, and J. Wittes, Ecology Pollution Environment, W.B. Saunders Company, 1972.

## Credit

"An Energy Education/Conservation Curriculum Guide for Home Economics Teachers," University of Tennessee Environment Center and College of Home Economics, Knoxville

## Notes To Myself

# STUDENT PAGE

TO THE STUDENT: Below is a list of items and activities which require energy for their manufacture, use or disposal. Number (rank) these items in order of importance and necessity to you. Mark your responses in Column A - number 1 being most important through number 20 for least important.

| | | B | C |
|---|---|---|---|
| ______ | hot water for bathing | ______ | ______ |
| ______ | electric toothbrush | ______ | ______ |
| ______ | waffle iron | ______ | ______ |
| ______ | synthetic clothing | ______ | ______ |
| ______ | reading a book | ______ | ______ |
| ______ | eating a raw apple | ______ | ______ |
| ______ | TV dinners | ______ | ______ |
| ______ | car ride to the store | ______ | ______ |
| ______ | drive-in movie | ______ | ______ |
| ______ | making homemade ice cream | ______ | ______ |
| ______ | lipstick or cologne | ______ | ______ |
| ______ | aerosol deodorant | ______ | ______ |
| ______ | electric hairdryer | ______ | ______ |
| ______ | bicycle riding | ______ | ______ |
| ______ | a walk in the sun | ______ | ______ |
| ______ | candy | ______ | ______ |
| ______ | nighttime football game | ______ | ______ |
| ______ | hot lunches | ______ | ______ |
| ______ | school buses | ______ | ______ |
| ______ | watching television | ______ | ______ |

A) Now that you have ranked these items according to their importance to you, go back and rank the ones you feel are most energy intensive (use the most energy) in Column B (from 1 to 10). Discuss your answers in class.

B) Now mark in Column C the items you could sacrifice which would help conserve energy. Discuss your answers in class.

C) In the event of an energy crisis and a mandatory 25% cutback in energy useage, what items would you eliminate?

## Curriculum Topic

Transportation

## Energy Topic

Energy Conservation

## Grade Level(s)

4-6

## Site

Classroom

## Skills

Recognizing problems, identifying alternatives, identifying feelings about alternatives

**Credit** Your Energy World, Unit Two, "Transportation: The Energy Eater", U.S. Department of Energy, Technical Information Center, Oakridge, Tennessee 37830

## Objective

The student will be able to:

1. identify 5 strategies used to change people's behavior.
2. link each strategy with a proposed method of energy conservation as it relates to transportation habits.

## To The Teacher

Transportation patterns throughout the world have changed dramatically during the past 200 years since the first steam engine was developed by James Watt in 1776. From foot power and horse and other animal power we have moved to energy-intensive two-ton automobiles, jet airplanes, even space vehicles. Little more than a hundred years ago, we depended entirely on human and animal energy, wood, and coal to move people and goods from one place to another. However, two events that happened within two years of each other changed the cource of the world.

In 1859, the first oil well was put down in Pennsylvania and in 1860, Etienne Lenoir of France produced the first practical internal combustion engine. By the early years of the twentieth century, trains, automobiles, and airplanes were powered by petroleum.

Today, the transportation sector accounts for one-quarter of the total U.S. energy consumption and 60 percent of the total U.S. petroleum consumption. These are direct costs only for gasoline, diesel and jet fuel, and motor oil. If all the indirect costs--which include vehicle manufacturing, fuel refining, road building, extraction of metals and other raw materials--were added, the total U.S. energy consumption for transporation would be much greater than 25 percent.

Motor vehicles use about three-fourths of all the transportation energy. There are 100 million automobiles in the U.S. and more licensed drivers than there are registered voters. Statistically, two new cars are produced for every American baby born each day. Motor vehicle industries employ one out of every six American workers.

Even though high-speed cars and planes have increased the comfort and convenience of our lives, the demand for petroleum to fuel them has created and intensified a range of domestic problems, has influenced our political relations with other countries, and has affected the economies of the entire world. We are experiencing serious environmental disruption--particularly air pollution; we now must import approximately half of the oil we use from foreign sources; and inflation has driven up the price of consumer goods each year.

Conservation in the transportation sector, more than in any other area of our life can achieve immediately observable results in important energy savings. If, for example, the fuel consumption of every car in the country were reduced by 50 gallons of gasoline each year--only one gallon a week--we could save seven percent of the total demand for gasoline. Conservation practices such as greater engine efficiency (more miles to the gallon), more passengers per car, better driving practices, and good maintenance can mean fuel economy and dollars saved. A closer look at other energy-efficient means of transportation--bicycling, walking, public transportation--can effect even greater energy savings. We can travel short distances between cities by rail or by bus--rather than plane or private automobile. By again shipping greater amounts of freight by train instead of by truck or cargo plane, we can save even more energy.

## Before You Begin

Duplicate copies of the Student Page "The Conservation Planner."

## Words To Know

Allocation, incentive, regulation, persuasion

# ACTIVITY

1. Pass out the activity sheets, read the examples through with students to become familiar with the new vocabulary, and ask them to think about the five situations that are described on the master.

2. After they have considered all five of the circumstances described they may either write their answers in the space provided or discuss them with the class.

3. Students can then link each strategy with a proposed method of energy conservation. Instead of lunch desserts (situation 1), ask the students about higher prices and taxes on energy. If the Congress passes laws for higher prices and more taxes on gasoline, and salaries remain the same, will your family buy less gas or sacrifice something else in order to buy it? In the place of television viewing (situation 2), have them consider the idea of gas allocations: Should rationing of gasoline be imposed, and if so, how would your family use its portion? Government incentives (situation 3), can be debated: If buyers of small cars receive a tax break, would you give up the luxury features of a large car? Regulations on automobile use (situation 4), can be discussed: If downtown areas were closed to passenger car traffic to encourage the use of public transportation and to offset pollution, how would you feel? Persuasion (situation 5), can be applied to selling energy conservation measures: If you are shown that conserving energy can make us more independent as a nation, can stretch the supplies of fossil fuels to give us time to develop other energy sources, and can save us money, will you and your family conserve voluntarily?

4. On the reverse side of the activity sheet, students and their families can work out a family "automobile-use budget" for one week. Suggest that they try to combine errands, make only necessary trips, use footpower or bicycles whenever possible. The students can work incentives or penalties into the program if they want to. When the week is up, the family can evaluate its experience, and students can report on the experiment to the class.

## Related Activities

1. Students may want to research automobile ads in the newspapers to compare costs for large and small cars. What features are the automobile sales people trying to sell? Be sure to discuss those car features that affect how much gasoline a car will use: car size, engine size, power equipment, air conditioning, automatic transmission, emission control devices. Have students check used car ads, too. What kinds of cars are most available as used cars? Are there many small used cars available? You may want to talk about prices and supply and demand in your community.

2. Discuss with students what some of the other costs are in owning a car besides the purchase price (costs such as maintenance, repairs, tires, insurance, parking, tools, taxes, gasoline, oil, antifreeze, depreciation).

# STUDENT PAGE
## THE CONSERVATION PLANNER

**DIRECTIONS:** Five different strategies are often used to change people's behavior. These strategies can be used to encourage people to conserve energy, too. For each of the five examples given below, state what you would do in each case. Later, you will relate each strategy to energy conservation.

### 1. HIGHER PRICES OR TAXES

If the cost of school lunch desserts goes up, and your allowance does not, will you buy fewer desserts or go without something else to buy desserts?

### 2. ALLOCATION

If you could watch only two hours of television a day, how would you budget your time?

### 3. INCENTIVE

What would you do if your parents offered you a dollar to watch your little brother and you'd rather play ball?

### 4. REGULATION

How would you feel if the town council said that only children under 8 years old could play in the park playground?

### 5. PERSUASION

If your leader at camp shows you the advantages of wearing raingear and boots when the weather is bad (your clothes stay dry; you can play in the puddles; you don't have to stay in the tent; and everyone else thinks it's a great idea), how do you react to his guidance?

FAMILY AUTOMOBILE-USE BUDGET

Together with your family, work out an "automobile-use budget" for one week. Write down on the reverse side of this page how the car will be used for the next seven days and try to stick to your plan. Combine trips; make only necessary trips; use footpower or bicycles whenever possible. Build any of the five strategies on this page into your plan.

# Energy Checklist for the Home

## Curriculum Topic

Heat and Insulation
Culture
Economics

## Energy Topic

Energy Conservation
Energy and Economics

## Grade Level(s)

5-6

## Site

Home, Classroom

## Skills

Locating and obtaining information
Concluding

## Credit

"Tips for Energy Savers
Energy Conservation in the Home
U.S. Department of Energy.
Adapted by Thomas J. Kotulski,
EARTHWATCH, Vol. II
Environmental Education Center
Area Cooperative Educational
Services, New Haven, CT, 1978

## Objective

Students will be able to:

1. generalize from the data their own habits in the use of energy,
2. identify areas where energy savings could be accomplished.

## To The Teacher

This activity is to identify, for students, areas of their own life-styles where energy-conservation practices could be instituted. It does not quantify energy-loss nor estimate the cost of alleviating the problem, but rather, gives students an over-all picture of their energy-consumption practices. One way to use this activity is to assign it as homework during an energy study unit.

1. Energy from the sun: How is you house insulated/heated?
2. The 2nd law of thermodynamics: Energy wasted in the home is energy and money permanently lost.
3. Sea and land breezes: Heating and cooling the home.

"Americans use more energy per person than any other people in the world. We have only 6 percent of the world 's population, but we use about one-third of all the energy consumed on this globe. Our total national energy cost in 1975 amounted to about $170 billion, and each year this cost is steadily rising.

"Where does all this energy go?

"Our industry takes about 36 per cent. Our commerce uses about 11 percent for enterprises including stores, offices, schools, and hospitals. Our residences take about 26 per cent. And transportation accounts for another 29 per cent or so.

"Most of the energy we use in the United States comes from petroleum (crude oil). Because domestic production falls short of our needs, we have to import almost half of it, at a cost of $45 billion a year (at 1977 rates).

"Expert estimates of our known and potential domestic reserves vary, but most likely we have somewhere between a 25 to 30 year supply of oil, if we keep our energy-use growth rate at about 2 per cent per year.

"However, if we continue using energy as we have become accustomed to, we could run out of domestic oil supplies in the year 2007, and we may run out of natural gas even sooner. The severe winter of 1976-1977 painfully dramatized the natural gas situation with its complex supply and economic problems.

"The overall energy situation in the United States is not rosy: Energy demand keeps rising; energy prices keep going up; the availability and future costs of supplies remain uncertain.

"What can we do about it?

"Conserve energy. This will help us extend our supplies and reduce our import burdens until we develop new energy technologies and resources.

"Without personal hardship, we could easily cut our energy use by an estimated 30 per cent or more -- saving energy for our country and money for ourselves.

"The energy we use for our homes and automobiles -- gas, oil, electricity -- draws on all of our energy resources. Cutting back on these uses is the simplest, most effective way to make our resources last longer. And each individual conservation effort, multiplied by millions, can serve as an "energy bank" -- a supply that can be used to help balance our energy accounts." (From "Tips for Energy Savers")

## Words To Know

energy conservation, insulation

# ACTIVITY

1. Hand out the "Residential Energy Checklist" as a homework assignment.

2. On the next day, tabulate the class results and discuss. Students can make a list of key areas of energy waste and compare it to corresponding lists of energy-saving procedures.

## Resources

Energy Conservation in the Home; U.S. Department of Energy

"Tips for Energy Savers", Federal Energy Administration 77/212, August, 1977: excellent.

## Credit

Checklist excerpted from Energy Conservation in the Home; University of Tennessee, 1976.

## Notes To Myself

--If you answered with 65 or more yes's, you are truly an energy conserver and will make a good conservation advocate.

--If you answered with 55 to 65 yes's, you are energy conscious but lack will-power or drive.

--If you answered with 45 to 54 yes's, you are wasting energy but with minor changes could make a conserver.

--If you answered with 35 to 44 yes's, you are an energy waster and should make an all-out effort to reform!

--If you answered with less than 35 yes's, you are making an effort to waste energy and should consider the long range and immediate effects!!

# STUDENT PAGE

## RESIDENTIAL ENERGY CHECKLIST

| House: The Shell | yes | no |
|---|---|---|
| 1. Are plants properly located around the house to provide a break against wind and shade against unwanted sun? | | |
| 2. Are drapes and furniture located so they do not obstruct heating, air-conditioning or ventilation? | | |
| 3. Are draperies insulated? | | |
| 4. Do draperies fit snugly around the window? | | |
| 5. Are exterior house doors closed quickly after use? | | |
| 6. Are lights and appliances turned off after use? | | |
| 7. Do you have storm windows and doors? | | |
| 8. Are all doors and windows properly caulked and weatherstripped? | | |
| 9. Are draperies and shades closed at night and on cloudy, windy days during the heating season? | | |
| 10. Are draperies opened to admit sunlight on sunny days in the heating season? | | |
| 11. Are draperies and shades closed on sunny days during the cooling season? | | |
| 12. Is the attic ventilated? | | |
| 13. Is the attic insulated to 6-8"? | | |
| 14. Are the walls insulated? | | |
| 15. Do floors exposed to unheated or cooled air have from 2-3½" of insulation? | | |
| 16. Is the fireplace damper closed when not in use? | | |
| 17. Is the den, gameroom or family room oriented to the south? | | |
| 18. Is the house shaded from the western sun? | | |

| | yes | no |
|---|---|---|
| 19. Does your home have window area equivalent to 10% or less of its square footage? | | |
| 20. Is your home sealed from drafts? Is it free from cracks and holes? | | |
| 21. Does your home have fluorescent lighting where appropriate? | | |
| 22. Does your home have wall-to-wall carpeting? | | |
| 23. Do all windows have drapery, shades, blinds, shutters or other covering? | | |
| Environmental Control | | |
| 24. Are ducts, radiators or air-conditioners closed off in unused rooms or closets? | | |
| 25. Are hot water pipes insulated in unheated and uncooled spaces? | | |
| 26. Are air ducts insulated in unheated and uncooled spaces? | | |
| 27. Is the thermostat set at 68°F or below during the heating season? | | |
| 28. Is the thermostat set at 78°F or above during the cooling season? | | |
| 29. Are heating and cooling filters clean? | | |
| 30. Is the thermostat turned back at night? | | |
| 31. Are windows and doors tightly closed while mechanically heating or cooling? | | |
| 32. Is an attic fan used in the summer? | | |
| 33. Do thermostats indicate correct temperature settings? | | |
| 34. Is an outside air-conditioning unit located on the shady (north) side of the house? | | |
| 35. Is the water heater insulated? | | |
| 36. Is the water heater temperature setting at 140°F or less? | | |

|  | yes | no |
|---|---|---|
| 37. Is the air-conditioning unit properly sized for your needs? |  |  |
| 38. Do you have a heat pump? |  |  |
| 39. Do you use natural ventilation as much as possible? |  |  |
| 40. Are radiators and other heating or cooling equipment clean and dust free? |  |  |
| 41. Is the water heater located in a heated space? |  |  |
| Housing Selection |  |  |
| 42. If you live in an apartment, is it an "inside" apartment? |  |  |
| 43. If you live in a mobile home, does it have a "skirt"? |  |  |
| 44. If you live in an older home, have its plumbing, wiring, insulation and chimneys been checked by "experts"? |  |  |
| Food |  |  |
| 45. Is the frost on the refrigerator and freezer less than ¼ inch thick? |  |  |
| 46. Is the refrigerator set at 40°F? |  |  |
| 47. Is the freezer set at 10°F? |  |  |
| 48. Are gaskets around refrigerators and freezers tight? |  |  |
| 49. Is the oven used to bake more than one food at a time? |  |  |
| 50. Is the gasket around ovens tight? |  |  |
| 51. Are frozen foods thawed completely before cooking? |  |  |
| 52. Is the cooking range turned off immediately after use? |  |  |

| | yes | no |
|---|---|---|
| 53. Are dishes washed only when there is a full load? | | |
| 54. Are dishes allowed to air dry? | | |
| 55. Are appliances clean and dust free (particularly cooling coils)? | | |
| 56. Is the oven never used as a dryer or heater? | | |
| 57. Are flat bottom pots and pans used? | | |
| 58. Is a timer used to avoid over-cooking? | | |
| 59. Are pots covered during cooking? | | |
| 60. Is as little water used as possible during cooking? | | |
| 61. Is the heated dry cycle on the dishwasher not used? | | |
| Clothing | | |
| 62. Does your family dress warmer in cool weather to avoid mechanical heating? | | |
| 63. Does your family dress cooler in warm weather to avoid mechanical cooling? | | |
| 64. Are clothes washed only when there is a full load? | | |
| 65. When washing is cold or warm water used when possible? | | |
| 66. Are clothes line dried when possible? | | |
| 67. Are most of your family's clothes wash-and-wear, permanent press to avoid dry cleaning and ironing? | | |
| 68. Are clothes always rinsed with cold water? | | |
| 69. Is the washer located near the water heater? | | |
| 70. Is the dryer lint screen cleaned after each load? | | |

| Personal Care | yes | no |
|---|---|---|
| 71. Do the members of your family take short showers or use only small amounts of water for tub baths? | | |
| 72. Are all water faucets repaired and not leaking? | | |
| 73. For washing, shaving or make-up is the lavatory filled rather than allowing water to run? | | |
| Entertainment | | |
| 74. Are entertainment devices turned off when not in use? | | |
| 75. Do members of your family try to entertain themselves rather than rely on devices? | | |

--If you answered with 65 or more yes's, you are truly an energy conserver and will make a good conservation advocate.

--If you answered with 55 to 65 yes's, you are energy conscious but lack will-power or drive.

--If you answered with 45 to 54 yes's, you are wasting energy but with minor changes could make a conserver.

--If you answered with 35 to 44 yes's, you are an energy waster and should make an all-out effort to reform!

--If you answered with less than 35 yes's, you are making an effort to waste energy and should consider the long range and immediate effects!!

# How Much Energy Do You Use?

### Curriculum Topic

Electricity

### Energy Topic

Energy Conservation
Energy Sources

### Grade Level(s)

6

### Site

Home, Classroom

### Skills

Locating and obtaining information, using information for a purpose, evaluating information

**Credit** "Household Energy," Individualized Science Instructional System, Ginn & Co., 1976. Adapted by Carla McGeeney in EARTHWATCH, Vol. II, Environmental Education Center, ACES New Haven, CT, 1978.

## Objective

The students will be able to:

1. Identify appliances in their homes which have heating elements.
2. Classify appliances according to wattage used.
3. Calculate approximately and exactly the wattage used.
4. Decide what appliances they could do without in order to conserve electricity.

## To The Teacher

Wattage refers to the amount of energy an appliance uses. Household power is measured in kilowatt hours (kwh): wattage multiplied by hours used, divided by 1000. For example, in four hours a 100-watt appliance uses 40 kwh of energy.

Different appliances use different amounts of power. Even different models of the same appliance vary considerably. When electrical energy is changed to heat, such as the heating element on a stove, power is used at a high rate. To conserve electrical energy in the home, therefore, though every conservation effort helps, restricting use of appliances with heating elements helps most of all. Insulation conserves electrical energy by keeping in the heat which electrical energy produces.

By reading the meter on one's house, a student can calculate exactly the amount of power used over a defined period of time.

To read the meter, record the numbers indicated by needles on the four (or five) dials. When the needle is between two numbers, read the lower number. Notice that the numbers on each dial reverse themselves. The number which is on the dial is not the number of kwh used. As the dials move around, the difference between two readings is the amount of power used.

## Before You Begin

1. Make a wall chart on which to keep recordings.
2. Make copies of the Appliance Chart (Student Page).

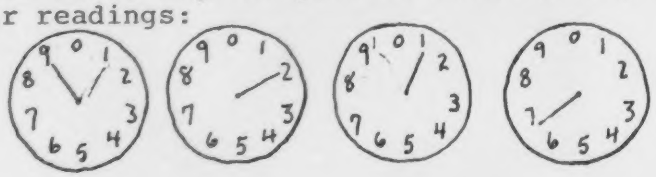
## Words To Know

wattage, killowatt (kwh), electric meter, energy conservation

COPYRIGHTED CARTOON DELETED

# ACTIVITY

1. Place the following examples of dials on the board and have students record their readings:



= 9217

2. Assign students to bring in readings taken in their homes at 8:00p.m. Record time, date and wattage for each student on a wall chart.

3. Assign a second reading to be taken exactly one week later to the time and day.

4. Subtract and record kwh used for each family.

5. Give students copies of the appliance chart included here. Ask each student to list appliances used in his/her family. List appliances using the greatest wattage and those using the least wattage.

6. Beside each appliance listing, ask students to estimate in hours (using fractions or decimals, if necessary) how much each is used per week. (Example: hairdryer 1.1 hours)

7. Calculate the kilowatt-hours (kwh) for each appliance a student uses

$$\frac{\text{wattage}}{1000} \quad \times \quad \text{hours used} \quad = \quad \text{kwh}$$

8. Which appliances use the most energy? Do appliances with the highes wattage have the highest energy use (kwh)? Why or why not?

9. Challenge students to cut back on electrical energy consumption. Have a contest to see who can cut back the most during the following week.

10. One week later, have students take a third reading at the same hour.

11. Have students with the greatest reduction in electrical energy use explain how they persuaded their families to decrease electrical use and appliances they were most able to restrict.

12. Discuss ways to conserve energy. The following will help start the discussion:

    a) take shorter, cooler showers

    b) skip drying cycle in dishwasher, air-dry

    c) hang clothes outside to dry whenever possible

    d) keep thermostat set low

13. Conduct a discussion on the reasons for conserving energy:

    a) save money for the family

    b) save natural resources

    c) reduce pollution

    d) make the United States more energy independent

    e) make energy available for industry

# STUDENT PAGE

DIRECTIONS:

1) IN COLUMN I, CHECK ALL THE APPLIANCES YOUR FAMILY USED LAST WEEK.

2) IN COLUMN III, ESTIMATE THE NUMBER OF HOURS YOUR FAMILY USED EACH APPLIANCE LAST WEEK.

3) IN COLUMN IV, CALCULATE THE KILOWATT HOURS (KWH) OR THE ENERGY USED BY EACH APPLIANCE IN A WEEK. USE THE FORMULA BELOW:

$$\frac{\text{WATTAGE}}{1000} \times \text{HOURS USED} = \text{KWH}$$

| APPLIANCE | COL.1 (✓) | COL.2 WATTAGE | COL. 3 HOURS USED | COL. 4 KWH USED |
|---|---|---|---|---|
| HOME HEATING UNIT | | 12,000 | | |
| OVEN (STOVE) | | 12,000 | | |
| CLOTHES DRYER | | 5,000 | | |
| WATER HEATER (QUICK) | | 4,500 | | |
| WATER HEATER (STANDARD) | | 2,500 | | |
| AIR CONDITIONER | | 1,500 | | |
| BROILER | | 1,500 | | |
| DEEP FAT FRYER | | 1,500 | | |
| PORTABLE HEATER | | 1,300 | | |
| DISHWASHER | | 1,200 | | |
| FRYING PAN | | 1,200 | | |
| TOASTER | | 1,200 | | |
| IRON | | 1,000 | | |
| COFFEE MAKER | | 900 | | |
| VACUUM CLEANER | | 650 | | |
| FROSTLESS REF/ FREEZER | | 600 | | |
| FOOD DISPOSAL | | 500 | | |
| HAIR DRYER | | 400 | | |
| T.V. (COLOR) | | 350 | | |
| T.V. (B & W) | | 250 | | |
| FLOOR POLISHER | | 300 | | |
| INFRARED HEAT LAMP | | 250 | | |
| WINDOW FAN | | 200 | | |
| CARVING KNIFE | | 100 | | |

STUDENT PAGE, CONT'D.

| | | | | |
|---|---|---|---|---|
| FOOD BLENDER | | 400 | | |
| STEREO | | 100 | | |
| SEWING MACHINE | | 75 | | |
| RADIO | | 70 | | |
| SHAVER | | 15 | | |
| TOOTHBRUSH | | 7 | | |
| CLOCK | | 2 | | |

## Related Activities

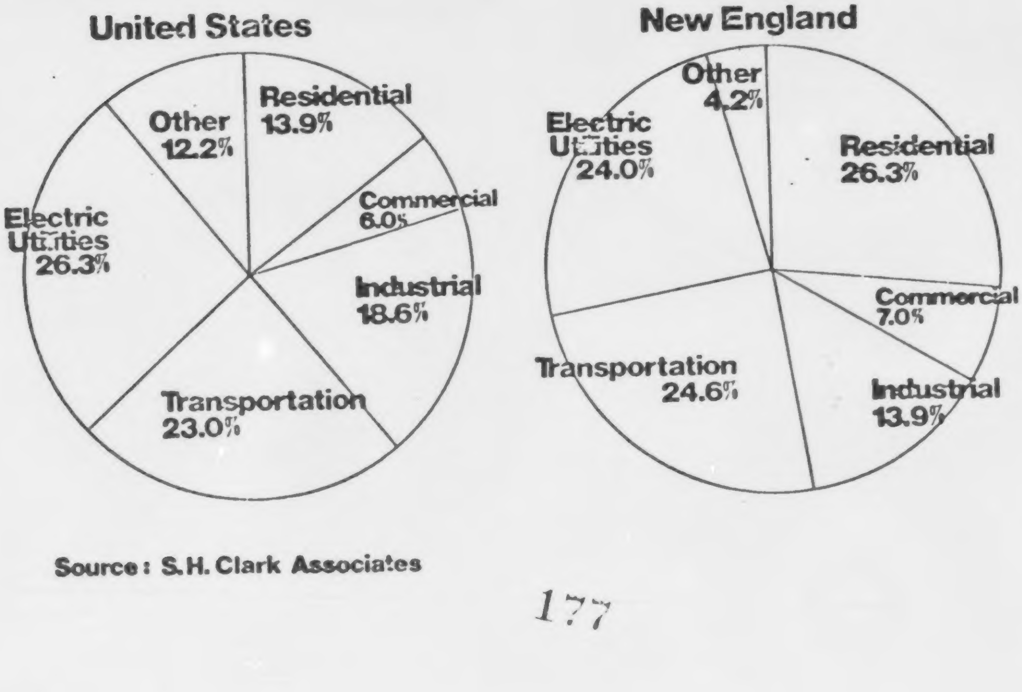
Select a student to call the electric company to learn the rates charged per kwh. Determine the amount of money saved from the energy conserved during the second week.

## Credit

"Household Energy," Individualized Science Instructional System, Ginn and Company, 1976

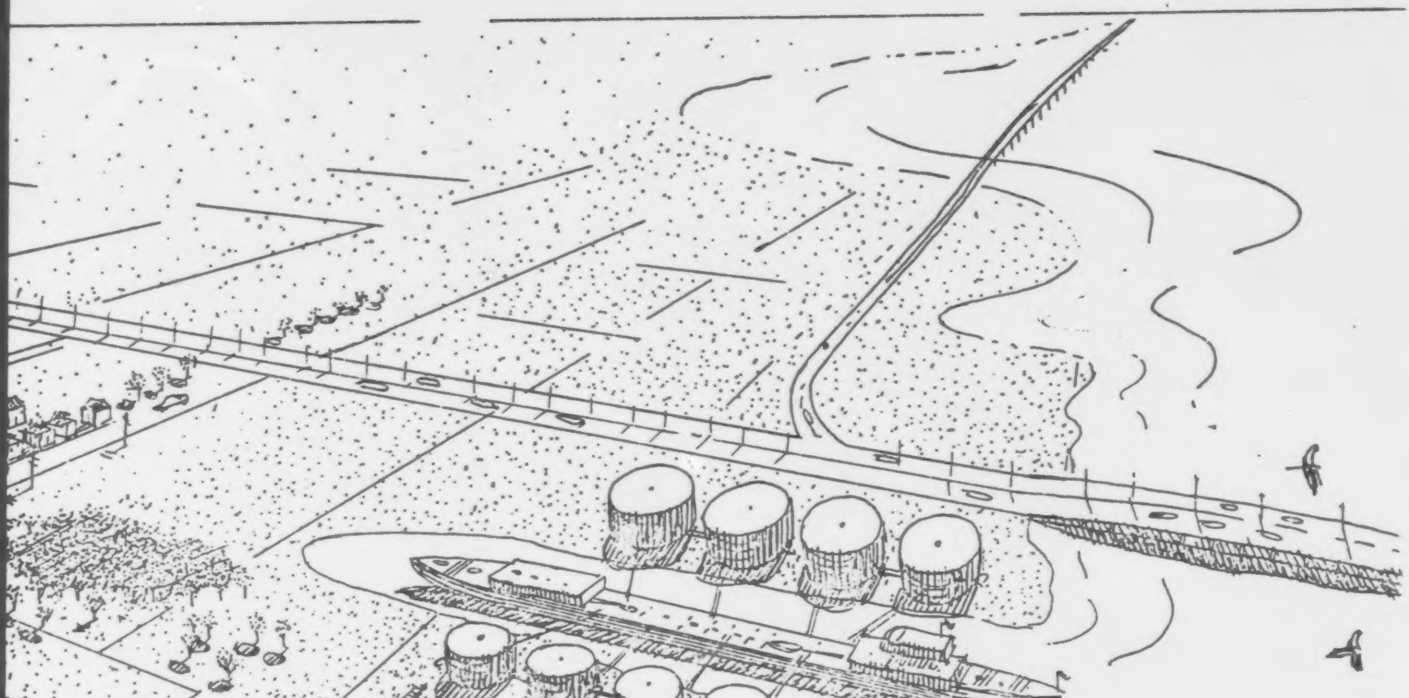
## Notes To Myself

Energy Consumption by Sector
1976



Source: S.H. Clark Associates

# ENERGY AND ECONOMICS



# ENERGY AND ECONOMICS

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# ENERGY AND ECONOMY

Energy is the driving power for civilization. It is both a raw material and a "laborer" in industry. It is necessary for our comfort, communication, and transportation. The industrialized countries are the large consumers of energy; high standards of living mean high per capita consumption.

Energy consumption is correlated with the gross national product (GNP), the dollar value of the goods and services produced by a country. It is the indicator of economic strength. We saw evidence of a negative sort in the drop of the GNP during the oil embargo. Positive evidence is provided by the fact that almost all countries which have high per capita GNPs also have high per capita energy consumption.

More important than the relationship between energy and the nation's financial status is the one between energy and individual finances. One end of the relationship between energy and people is the area of employment.

Evidence of the strong tie between energy and employment is not difficult to find. The oil embargo showed a direct connection. The sudden reduction in oil consumption forced on us resulted in the temporary loss of some 500,000 jobs. Most of these were in industries that deal with energy directly--service stations and airlines, for instance--with the others in the automotive and automotive-related industries.

There are also many examples of longer-range changes in which energy played an essential role. When the gas pipelines were finished in the post-war years and natural gas became available in the East, it displaced coal from many markets. The consequent loss of 300,000 jobs in the coal industry since 1947 created problems for Appalachia which have never been really solved.

Changes in the total energy consumed and in the mix of energy forms in use have their greatest impact on two industry groups: those that produce energy as a product and those that use large amounts of energy essentially as a raw material. The energy industries and those for which energy serves as a raw material account for only 10 percent of the total work force. Although certain industries (utilities, gas and oil retailers, chemical and paper) have shown significant increases in employment since 1950 (but none as high as the average increase of 41 percent) the group as a whole has remained largely static. Thus the few-percent change in the total amount of energy consumed under the various energy policy options open to us will not be expected to cause large changes in employment.

It is, in fact, possible to conceive of an increase in employment in a future with reduced energy consumption. A swing away from the capital-intensive energy industries to labor-intensive service industries would increase employment. As just one example of a low-energy future with higher employment, we can point to the energy savings that would accrue from building fewer automobiles, but building them to last. We would find, in all likelihood, that more person hours per car would be required to build to more stringent standards, but that whatever employment loss occurred would be compensated for by an increased need for repair and servicemen. The example also shows, however, that changes in the energy-employment picture must have long lead times in order to provide the training and retraining the job changes will require.

It does not appear then that a drastic decline in employment is a necessary consequence of a reduction in energy consumption nor, in fact, that an increase will increase employment. Energy and many of the goods for which it is an important raw material make a bigger impact on capital gains and losses than on employment. We are, therefore, led to wonder what happens at the other end of the energy flow. Who buys it, in what form, and how much? We see that within average energy consumption patterns on a worldwide basis there are large disparities--that an average American uses about 50 times the energy an average Indian does. Are there similar disparities in our own country?

According to a recent survey, the average American household consumes a total of 86 million (M) Calories of primary energy each year. Six percent of the income of this average household is spent for this amount of energy, the equivalent of 846 gallons of gasoline, 142,000 cubic feet of natural gas (for heating and cooking) and 8,000 kilowatt-hours of electricity (the primary energy used to create this electricity is also included).

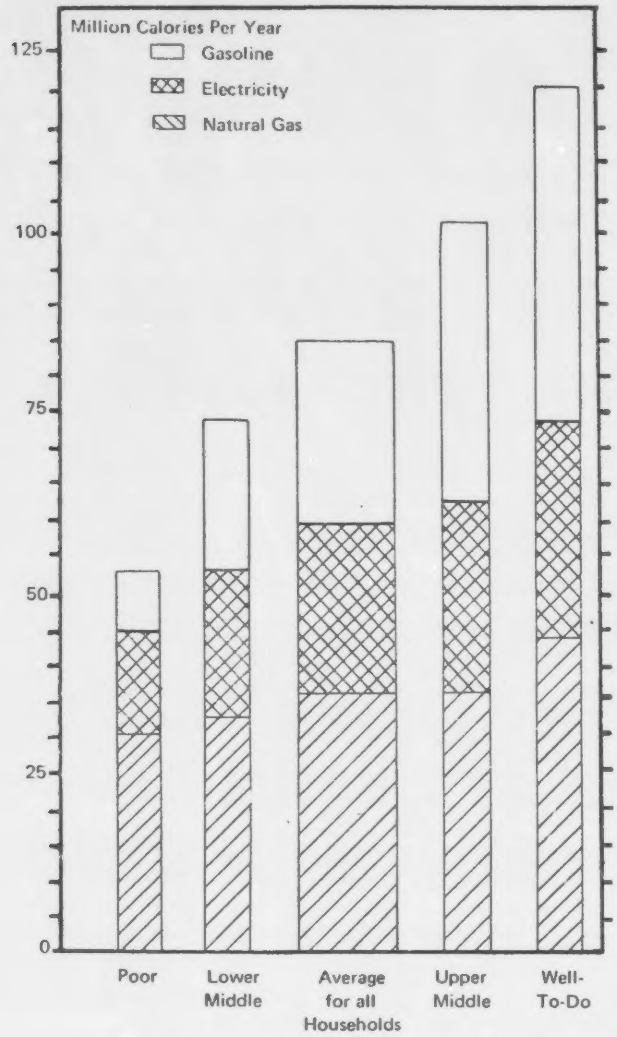
The first departure from this average comes if we look at household energy use as a function of income level. We see that although there are small differences in the use of basic energies--electricity and natural gas--over the range of incomes studied, the biggest difference is in gasoline consumption. The ratio of total consumption in the "well-to-do" household to the total consumption in the "poor" household (Figure 1) is about two to one, a much smaller ratio than that of their respective incomes. There is only so much direct energy one can use.

This last observation suggests that the poor may spend a larger share of their income on energy than do the rich. The poor use less energy than the rich, but spend a larger share of their income for it. And they pay more per Calorie for it, also, at least in the use of natural gas and electricity, for which rates are lower for the large-volume user.

The study goes on to look at the various end uses for energy and at the rich/poor differential. It found, for instance, that although the poor live in smaller houses and apartments, they are less well-insulated, and as a result they require about as much natural gas to heat as do the houses of those in higher-income brackets.

**Household Energy Use by Income Group**

*Figure 1*



Source: Washington Center for Metropolitan Studies.

Note: Includes only natural gas, electricity, and gasoline.

So we see that energy like wealth is inequitably distributed in this country. The danger of the present trend is that increasing energy prices will widen the energy gap.

Another troublesome part of the energy web is the energy needed by the food system. What we find on analysis is that year by year the number of Calories that must go into the system in order to get a food Calorie out is now about 10, and growing. The food crisis and the energy crisis are thus firmly joined.

The most important conclusion we can draw from the many aspects of the energy system is that careful planning is needed. We have crossed a new frontier into an era of expensive energy; the familiar landmarks are gone. We can continue our journey only with a carefully drawn map, an energy policy, which must incorporate strategies for energy conservation.[1]

---

[1] Largely based on The Energy-Environment Source Book, John M. Fowler, National Science Teachers Association, 1975.

THE GASOLINE GAME

## Curriculum Topic

Careers
The Community
Transportation

## Energy Topic

Energy and Economics
Energy Uses

## Grade Level(s)

2-3

## Site

Classroom

## Skills

Recognizing problems, computing, listening with comprehension, group skills

**Credit** Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, 1977.

## Objective

Students should be able to:

1. Identify oil as the source of energy the gasoline attendant works with and describe his duties.
2. List various things that are made from oil.
3. Determine ways in which the gasoline station attendant's job is dependent on oil.
4. Demonstrate the ability to solve story problems through addition of two place numbers.

## To The Teacher

This lesson develops the children's understanding of a community worker whose job depends on the delivery of energy. It deals with the gasoline station attendant whose job is close to the students, and one that can help them understand how energy can serve the community.

Gasoline is just one of the many fuels made out of oil. Oil is a fossil fuel that is found underground and under the sea. It is collected by drilling and stored in large tanks until used.

Children might confuse gasoline with natural gas. Gasoline is a liquid, natural gas is a gas.

It is recommended that you use gasoline throughout this lesson to eliminate some confusion over the terms.

Gasoline station attendants have as their major duty, pumping gasoline, but they must also keep a record of the amount of gasoline stored at the station. Attendants also check oil and water in the cars and provide various personalized services for the customers.

## Before You Begin

You will need to duplicate class copies of these Student Pages:

- Picture of the gas station attendant
- Gas Station Helper ditto
- Gas Station Game ditto

Also, collect the following materials:

- Piece of foam rubber
- Plastic wrap
- Empty gasoline can
- A record
- Pencils, paper, crayons
- Dice
- Lipstick
- Candle
- Styrofoam
- Vaseline
- Lighter fluid

## Words To Know

gasoline

# ACTIVITY

Part A

1. One way to begin this lesson is to show the class several items that are made from oil. Items: Styrofoam, piece of plastic, a plastic record, lipstick, candle, Vaseline, lighter fluid, etc. Ask: Can anyone tell me what these things are made from? (Accept all guesses.) Ask: They were made from a fossil fuel that is a liquid. Can anybody tell me which one? (Oil.) Is gasoline made from oil? (Yes.) Where have you seen gasoline used? (In machines, at gasoline filling stations, etc.)

2. Show students the picture of the gasoline station attendant. Ask questions to develop the lesson:

a. Where is the automobile? (Gasoline station.)
b. Who is the person standing? (Gasoline station attendant.)
c. What is the person doing? (Pumping gasoline.)
d. What is the source of the gasoline being pumped? Do you remember what source gasoline comes from? (Oil)
e. What else does the gasoline station attendant do? (Check oil and water, fill battery, wipe windshields, etc.)
f. Why is this person's job important to the community? (People need gasoline for cars, lawn mowers, etc.)
g. What would happen to this person's job if there was no more gasoline? (He would lose it. He wouldn't have any money.)
h. What can people in the community do to save gasoline? (Car pool, walk, ride bikes, take fewer trips, drive slower, etc.)

3. An Automobile Pantomime: Tell children they might like to be parts of a car. They are to come up to the front of the room and make themselves look like a certain part of the car. A child may choose to become the motor, and other children to be the front end, back end, four wheels, and a driver. Ask: What do we need to make the car go? (Gasoline) Who puts gas in the car? (Gasoline station attendant.) Have a child volunteer to put gasoline in the car. Ask: What does the driver have to give the attendant? (Money to pay for the gasoline.) What can the car do now that it has gas? (Move.) Let all the children who make up the car move forward together. Have several other children come to the front of the room and become parts of a larger car -- a truck perhaps. Follow the same procedures, and ask questions that would elicit the response that a bigger car uses more gasoline than a small one. Perhaps they will infer this idea by the number of children needed to form the larger car.

4. When the children return to their seats, say: Let's make up a story about the gasoline station attendant. What words will we need to know? Write these words on the chalkboard as the children suggest them: station, driver, pump, gasoline, dollars. (You may add other words to this brief list.) Allow plenty of time for the children to look at the words. Have children suggest sentences that would be good to use in a story about the gasoline station attendant. Write their suggestions on the board.

Part B.

1. Distribute copies of the Gas Station Helper and go over this page together with the class.

2. Divide the class into groups of 2-6 and distribute copies of Gas Game Board to each group and scorecard sheets to each student.

3. Go over the following directions with the class:

> Each player rolls a pair of dice. The one with the highest number goes first. First player rolls dice and writes number of the dice shown on his scorecard under "How many gallons?" He then computes the cost of the gas and writes it on his scorecard under "cost." Next player does the same. Each player gets 10 turns. Each player finds the total cost. If having a "winner" seems necessary, you might have the one with the lowest number declared the winner. There is no real point to be made of winners and losers.

Note. Students who need help with addition may use the chart with costs written on it.

Scorecard

Name ____________________

| How many gallons? | Cost: 60¢ per gallon |
|---|---|
| 1. ______ | ______ |
| 2. ______ | ______ |
| 3. ______ | ______ |
| 4. ______ | ______ |
| 5. ______ | ______ |
| 6. ______ | ______ |
| 7. ______ | ______ |
| 8. ______ | ______ |
| 9. ______ | ______ |
| 10. ______ | ______ |

To vary, change the cost of the gas.

Chart

| How many gallons? | Cost |
|---|---|
| 1 | 1.20 |
| 2 | 2.40 |
| 3 | 3.60 |
| 4 | 4.80 |
| 5 | 6.00 |
| 6 | 7.20 |
| 7 | 8.40 |
| 8 | 9.60 |
| 9 | 10.80 |
| 10 | 12.00 |
| 11 | 13.20 |
| 12 | 14.40 |

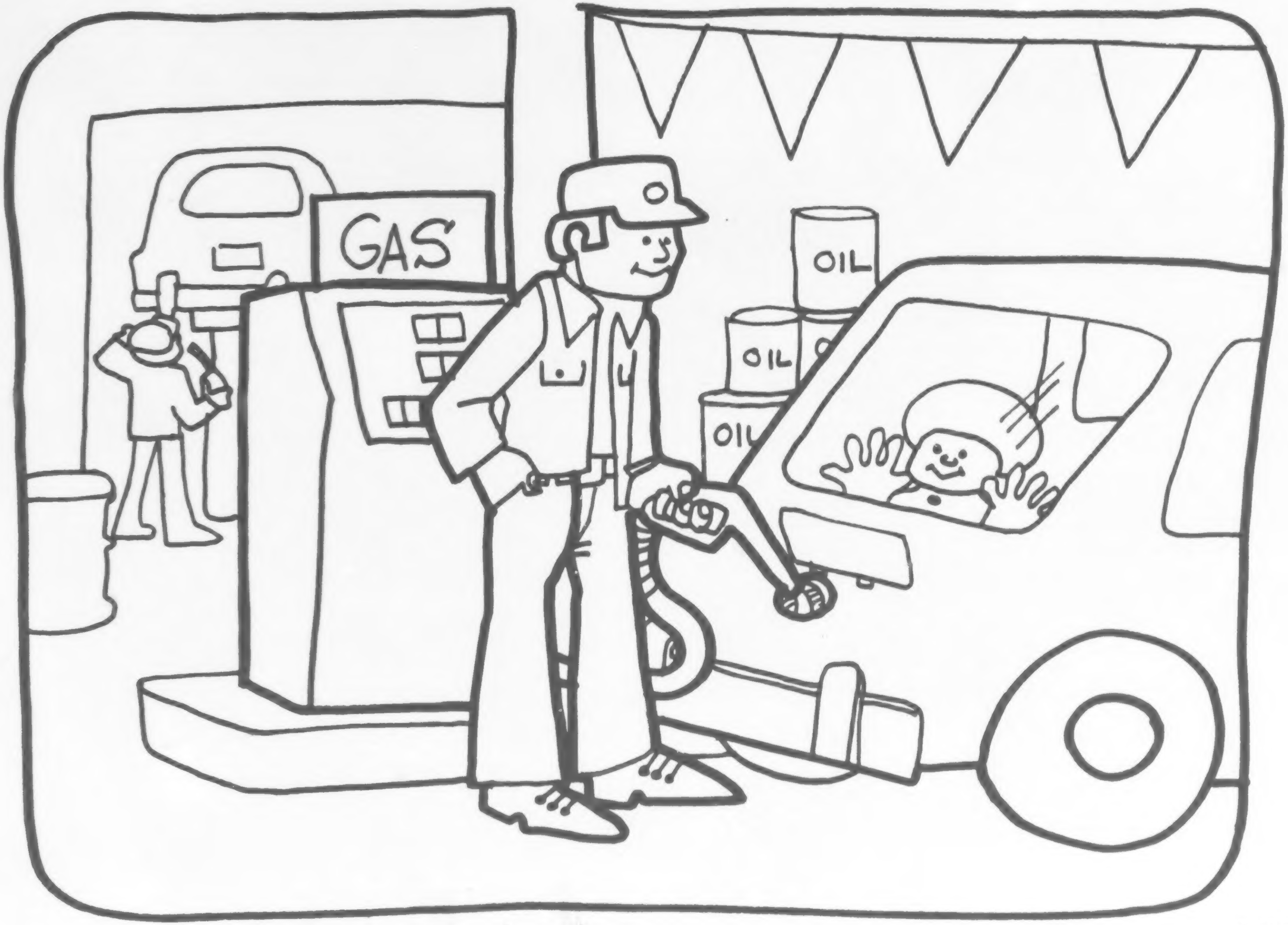
## Related Activities

1. Field trips: Arrange for the class to visit a nearby gas station and/or a tank farm. Help them make a list of things they want to find out in preparing for the trip.

2. Resource persons: Any of the following persons might be invited to talk to the class: station owner, attendant, repairman, mechanic, an oil company executive.

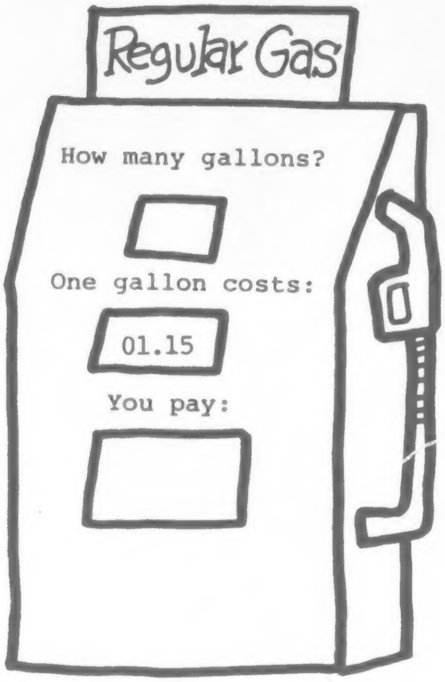
## Notes To Myself

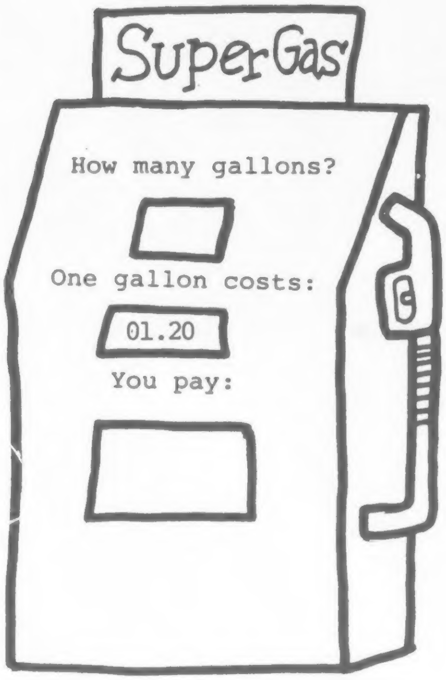
**STUDENT PAGE**


GAS
OIL
OIL
OIL

# STUDENT PAGE

## Gasoline Station Helper


Regular Gas
How many gallons?
One gallon costs:
01.15
You pay:


Super Gas
How many gallons?
One gallon costs:
01.20
You pay:

Purposes: To review addition skills.
To learn what a gas station helper does.

Today, you are a gas station helper. A car drives up. The driver says, "How much is your super gas?" You say, "Super gas is ______ cents a gallon."

The driver says, "I want 5 gallons." You take off the cap of his gas tank. You put in the gas pump. The dials turn. Now 5 gallons have gone into his tank. You take out the pump and put the cap back on his gas tank. You say, "That will be ______ dollars, please."

How do you get the answer?

$$\begin{array}{r} 1.20 \\ 1.20 \\ 1.20 \\ 1.20 \\ +\ 1.20 \\ \hline \end{array}$$

Now ask your teacher for the Gas Pump Game.

# STUDENT PAGE

## GAS GAME BOARD

# GAS

**HOW MANY GALLONS?**

| | |
|---|---|
| | |

**ONE GALLON COSTS**

| | |
|---|---|
| | |

**YOU PAY**

| | | | |
|---|---|---|---|
| $ | | | |

# STUDENT PAGE

## SCORE CARD

NAME________________________

| How Many Gallons? | Cost |
|---|---|
| 1. | |
| 2. | |
| 3. | |
| 4. | |
| 5. | |
| 6. | |
| 7. | |
| 8. | |
| 9. | |
| 10. | |

## CHART

| How Many Gallons? | Cost |
|---|---|
| 1 | 1.20 |
| 2 | 2.40 |
| 3 | 3.60 |
| 4 | 4.80 |
| 5 | 6.00 |
| 6 | 7.20 |
| 7 | 8.40 |
| 8 | 9.60 |
| 9 | 10.80 |
| 10 | 12.00 |
| 11 | 13.20 |
| 12 | 14.40 |

## THE FARMER'S FUEL

### Curriculum Topic

Careers
The Community
Plants

### Energy Topic

Energy and Economics
Energy Uses
Energy Sources

### Grade Level(s)

2-3

### Site

Classroom

### Skills

Experimenting
Collecting and compiling data
Predicting

**Credit** Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN, 1977.

### Objective

Students should be able to:

1. Identify the sun as a source of energy.
2. Describe heat and light as forms of energy released from the sun.
3. Describe how the farmer depends on the sun's energy and the contribution of his job to the community.

### To The Teacher

This lesson develops the student's awareness of how much the farmer depends on the sun's energy. It provides light for plants to grow, and these plants, in turn, are used to feed the community. Both sun and soil are renewable resources, for they can be used over and over again. The sun's energy is free to the farmer, as is rainwater. Plants can only grow with the sun's energy. Elementary concepts about these resources, and the beautiful balance of nature are introduced in this lesson.

We also want the student to know that the farmer uses much more energy than that of the sun. He needs gasoline for his machinery, and energy is used to make fertilizer, for example.

The farmer prepares his fields, plants the seeds, cares for the young plants as they come up, and harvests them when they are ripe. Some of the plants are sent to the food processor, some are used to feed the animals on the farm, and some are used for seed. To help him do all this work, the modern farmer has machines costing thousands of dollars.

These machines need energy to do their work. However, these machines would be valueless without the crops. It is the sun's energy that causes the plants to grow.

Green plants, growing in sunlight, use the energy from the sun to make carbohydrates from the water and air, since both of these contain carbon, hydrogen, and oxygen--all of which are necessary to make carbohydrates. To make protein, green plants add substances from the soil. As the plant grows, it captures and stores energy from the sun in a process called photosynthesis. This lesson calls attention to the sun as the beginning of the food chain.

## Before You Begin

You will need the following materials:

Seeds for planting: grass, radish, bean, and corn
Milk (or similar) containers
Pencils, paper, crayons
String
1 large box
1 shoe box
Aluminum foil

One class period is needed for motivation, discussion, and planting the seeds. Then observation of the germinating and growing process will require a ten to fifteen day span.

## Notes To Myself

# ACTIVITY

1. Show students a picture of farmers working in fields with the sun shining over them. Ask how these people help our community. Discuss solar energy, rainmaking, weather control, and chemical farming if the questioning period takes this direction.

2. Encourage students to talk about the sun's energy and the value of green plants. Discuss the importance of the farmer's job. Ask the children to name some food plants.

3. The accumulated information will furnish motivation for a classroom experiment in farming. Invite the children to make a mini-farm.

Put two inches of soil in a large box lined with foil. Mark off four rows with string. Let children plant, say, grass seed in one row, corn, radishes, and beans in the other rows. (Note: Any seeds will do as well, except those that need extra large amounts of growing space.)

4. Cover the seeds with 1/2 inch of soil. Corn can take an inch, however. Seed packets will provide information regarding soil depth and water requirements.

5. Put two inches of soil in another shoe box lines with foil. Let children scatter each kind of seed in it. Cover seeds with 1/2 inch of soil. Ask: How can we find out if plants need sunlight to grow? Encourage children to try putting one mini-farm in a completely dark place and see what happens. Ask children to predict what they think will happen to the seeds put in the dark.

Will the seeds germinate (become plants)? (Yes.) Will they grow tall? (Yes. Trying to reach some kind of light, they will probably grow tall, but will be very spindly. Without light, they will die eventually.)

6. A chart can be used to stimulate a discussion about the kinds of knowledge a farmer must have. Use the chart to develop skills in learning to understand the meaning and significance of the title, symbols, labels, and words on the chart. A chart about farming will provide practice in these skills.

7. Ask: What would a farmer need to know about seeds and plants? Make a chart listing their questions. It might look like the one below.

THINGS A FARMER NEEDS TO KNOW ABOUT PLANTS

Which plant will come up first?

Which plant will grow green and tall?

Which plant will grow thick?

Which plant may not grow?

8. Add two more columns on the right and have children predict the results of their mini-farm. As the mini-farm develops, make corrections in the Right Answer column.

FACTS WE LEARN FROM OUR EXPERIMENT

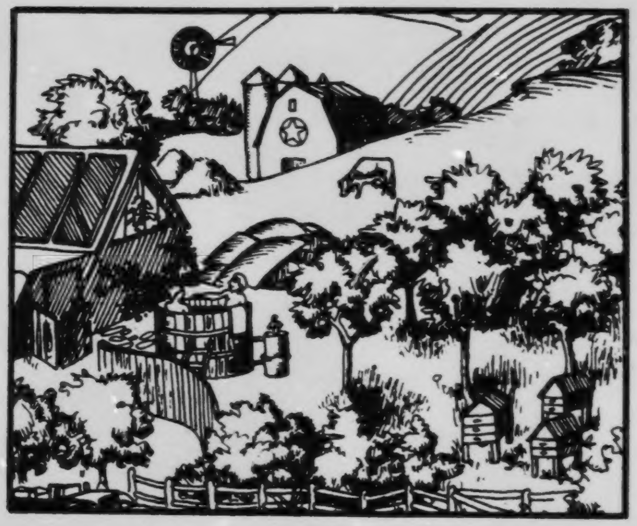
| | Guess | Right Answer |
|---|---|---|
| Which plant will come up first? | | |
| Which plant will grow green and tall? | | |
| Which plant will grow thick? | | |
| Which plant may not grow at all? | | |

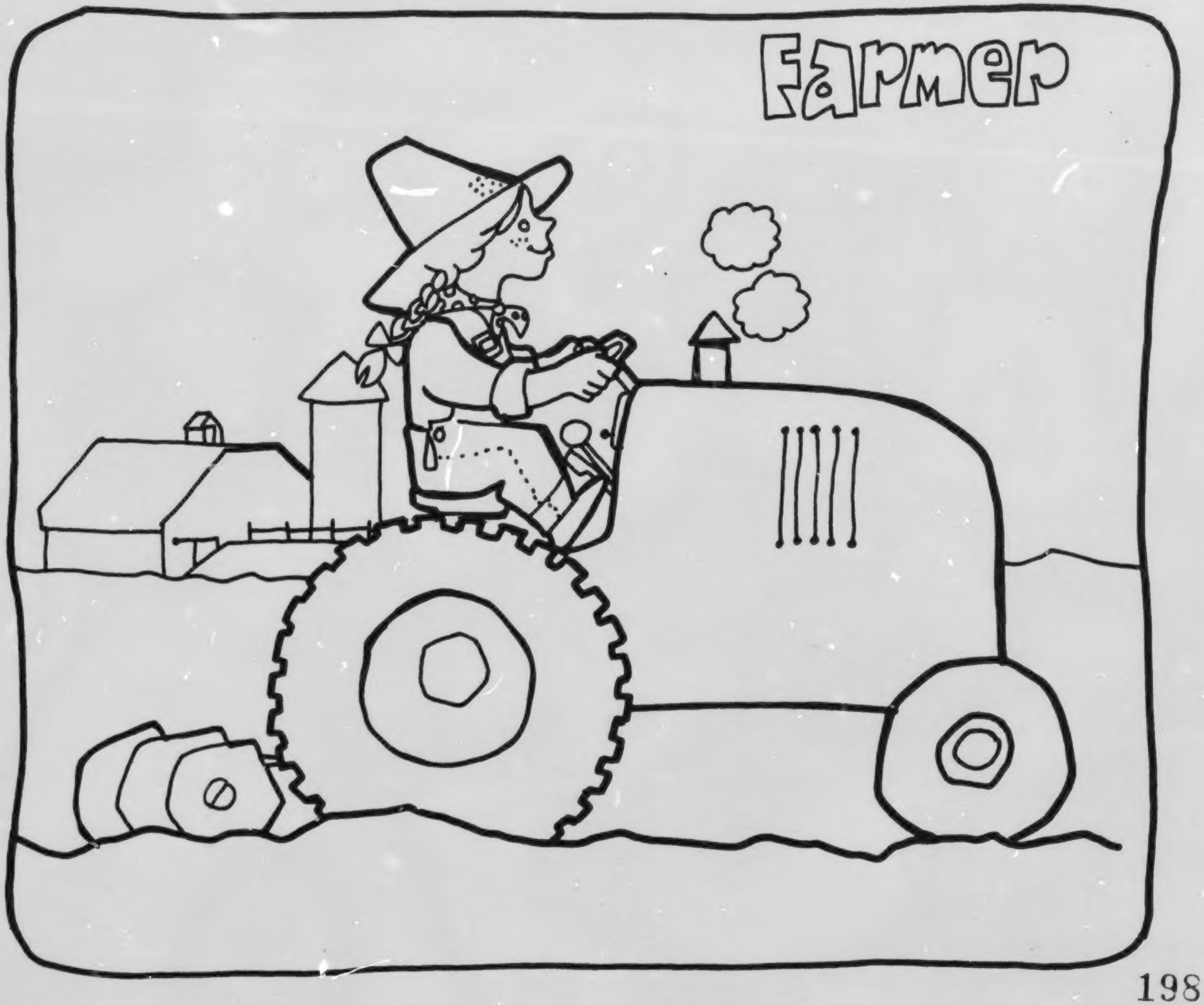
## Related Activities

1. Encourage students to make an Energy Worker Booklet. Cut out magazine pictures, or draw a picture of a farmer. Show the work a farmer does, and write a sentence about the sun.

2. Have the class visit a farm, or invite a farmer to speak to the class. In urban areas, contact the local park department to find an experimental farm for the children to visit.

3. Think of future jobs using solar energy. Then think up names for the workers who would do these jobs. (Example: build solar homes and schools.)





STUDENT PAGE

# YOUR CHOICE: PUBLIC OR PRIVATE

## Curriculum Topic

Transportation

## Energy Topic

Energy and Economics
Energy Conservation

## Grade Level(s)

3-4

## Site

Classroom, home

## Skills

Reading, identifying alternatives, collecting and compiling data, identifying consequences of alternatives.

## Credit

Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S Department of Energy, Technical Information Center, Oak Ridge, TN, 1977.

## Objective

The student should be able to:

1. Name at least two types of public and private transportation.
2. Chart transportation data.
3. Interpret transportation data and reach a decision based on the data.

## To The Teacher

There are more than 100 million automobiles in the U.S. These automobiles use some 76 billion gallons of gasoline each year - or about 14% of all the energy in the U.S., almost 3/4 of all gasoline used and 28% of all petroleum or oil. The importance of individual gasoline savings cannot be over emphasized.

Public transportation systems, the bus, subway, train, etc. grew from a need in the larger cities. During World War II, rationing of gasoline drove people to use public transportation instead of the car. But after the war people began to use the car because of comfort, convenience, and at that time low operating cost. Public transportation was for those who could not afford a car.

Several factors played a major role in the increased interest in public transportation in the 70's: the gasoline crisis, the energy crisis, and the growing knowledge that the gasoline engine was damaging to our environment.

Our living space, our energy resources, our atmosphere all are consumed by the auto. (Transit Fact Book, page 22, American Public

Transit Association).

As a result, more and more people are realizing the need for mass transit in the urban area. It is necessary to increase the quality of our lives in urban centers. Ridership is increasing as more people are attracted to mass transit.

## Before You Begin

Duplicate copies of the following student pages for each student:

Mr. Hernandez Goes to Work
Cost of Getting to Work
How People Get to Work

## Words To Know

Transportation

## Notes To Myself

# ACTIVITY

1. Begin the lesson by asking:

> How do members of your family get to work each day? (List responses on the board.)
>
> Have you heard of any other kinds of transportation? (Responses should include: car, bus, train, metroliner, motorcycle, bicycle, walk, etc.)
>
> Which of these types of transportation are "public" transportation? (Help students to distinguish between public and private means of transportation.)

Let's look at our list and label the forms of transportation - private or public. (Select various students to label each form of transportation. Private - car, motorcycle, bicycle, walking. Public - bus, train, metroliners, subways.)

> Which do you think costs the most per mile? (Have each student raise his hand to indicate his choice.) Is this a public or private form of transportation? Which do you think costs the least per mile? (Again, ask each student to vote for their choice.) Is this a public or private form of transportation? (Expected answer: Public.) If public transportation seems to be cheaper, why don't more people use it? (Possible responses: it's not available, it's not close to home, the schedule doesn't fit your needs, it's too slow, etc.)

"Today, let's find out how much it does cost to go to work by car, by bus, or by train."

2. Distribute copies of Mr. Hernandez Goes to Work and chart Cost of Getting to Work.

"Locate Mr. Hernandez's house. Let's suppose that Mr. Hernandez just moved into this house and he is trying to decide how he should go to work. Locate Mr. Hernandez's office. (Have students point to correct office building.) Mr. Hernandez has three choices. He can drive his car, take a bus, or take a train. Look at the chart called Cost of Getting to Work and compare the amount of money and time it takes for each form of transportation. Then you decide which you think is best. Use a pencil to trace the route you have chosen on the drawing."

3. Have one student read what is on the chart and discuss all terms used, i.e. "other costs" under car refer to insurance, repairs, replacement, etc. If necessary, work with small groups who need help with the assignment, while other students complete it independently. Write car, train, bus, on the board at the end of the allotted time. Ask:

> How many of you decided that Mr. Hernandez should use a car? (Write number by car.) A bus? (Record number.) A train? (Record number.)

4. Call on three students and have each go to the board and work the problem related to the total cost of using the car, bus, and train.

201

Answer:

| | | | |
|---|---|---|---|
| Car - Gasoline | $1.30 | Bus-$.60 | Train-$.80 |
| Parking | 2.00 | .60 | .80 |
| Other | .70 | | |
| | $4.00 | $1.20 | $1.60 |
| Time | 25 min. | 35 min. | 20 min. |

5. Allow time for students to discuss reasons for their choices. Ask:

> "Which type of transportation is less costly per mile: private or public?" (Public.)
>
> "Which do you think most people use?" (Allow students to hypothesize and accept any answer they give.) "Let's find out which type of transportation the people in our community use."

6. Distribute How People Get to Work and read the three questions. Give the class the assignment of asking any two adults the three questions and record their answers. They may ask family, neighbors, friends, teachers or any member of their community.

7. After they have completed the survey, have the following charts on the board:

Cost of Getting to Work

| | Car | Bus | Train | Other |
|---|---|---|---|---|
| Less than 1 mile | | | | |
| 2 - 5 | | | | |
| 5 - 10 | | | | |
| 10 - 15 | | | | |
| 15 or more | | | | |

Ask:

> How many people travel to work by car? (Record total by car. Do the same with bus and train. Discuss the other forms of transportation used and record total.)
>
> Now look at the number of miles each person traveled. How many traveled one mile or less by car? How much did it cost? (Enter this on chart and continue until all information is categorized. Or divide students into four groups: Car, Bus, Train, and Other and allow them to record the information.)

9. When chart is compiled, ask:

> What kind of transportation is used by most people? How many miles do most people travel? What do most people spend to go to work? Which type is most expensive? Least expensive? Which would save energy? Which do you think is the best way for people to go to work? How could the cost of driving cars be reduced? (By car pooling, buying cars with better gas mileage, etc.)

10. Look at the chart Cost of Getting to Work and ask:

> Which form of transportation uses the least amount of gasoline? Which uses the most? How can people save oil and energy? Which form of transportation is best when you consider time, cost and the amount of oil or energy used?

## Related Activities

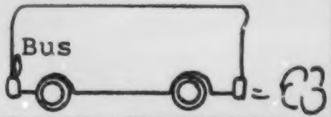
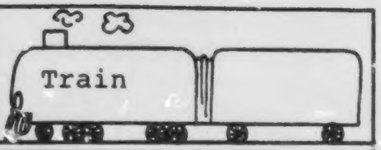
1. Have the students and a parent volunteer or aide, go in groups to a nearby intersection or even the school parking lot as they come to school. How many cars have only one passenger? How many cars have two passengers? Three? More? Make a simple horizontal bar graph or a simple picture graph to show what they found. (Thirty minutes or less is enough time for this activity.)

2. Have the students solve the following problem.

> Your family is going to take a vacation to Los Angeles, California. How would you go, by car, bus, airplane, or train? Find out how much it would cost for each kind of transportation. (You may wish to localize here and use some place closer to home for the students.)

COPYRIGHTED CARTOON DELETED

## Costs of Getting to Work

| | | | |
|---|---|---|---|
| Type of Transportation | <br>Car | <br>Bus | <br>Train |
| Costs | Gasoline:<br>one-way $ .75 | Fare:<br>one-way $ .60 | Fare:<br>one-way $ .80 |
| | Parking 2.00 | | |
| | Other cost .50 | | |
| | Total Costs | Total Costs | Total Costs |
| Time | One way<br>25 minutes | One way<br>35 minutes | One way<br>20 minutes |

Work the problems below:

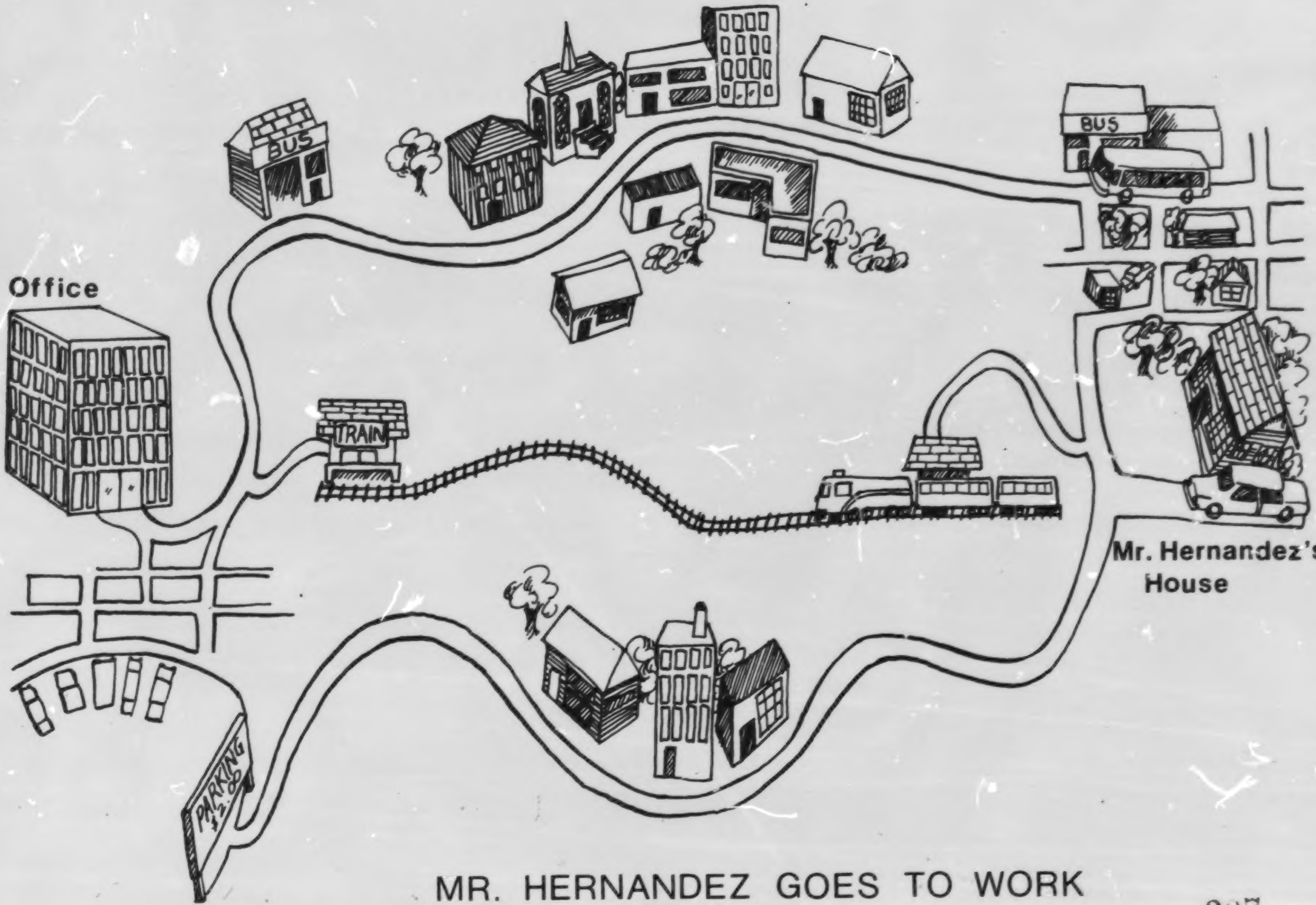
1. How much does it cost Mr. Hernandez to go to work and come home by car?

2. By bus?

3. By train?

4. How many minutes does it take him by car? by bus? by train?

5. Which do you think he should choose?


BUS
BUS
Office
TRAIN
Mr. Hernandez's House
PARKING $2.00

MR. HERNANDEZ GOES TO WORK

# STUDENT PAGE

## How People Get to Work

How far away from home is your place of work?

1st person ______________________________

2nd person ______________________________

How do you get to work?

1st person ______________________________

2nd person ______________________________

How much does it cost you one-way?

1st person ______________________________

2nd person ______________________________

# Alaska Priorities

## Curriculum Topic

Electricity
Alaska

## Energy Topic

Energy and Economics
Energy Conservation
Energy Sources
Energy Uses

## Grade Level(s)

4-6

## Site

Classroom

## Skills

Identifying feelings about alternatives, choosing freely, citizenship skills

**Credit** Clegg, Peter, New Low Cost Sources of Energy for the Home, Garden Way Publishing, 1975. Morrison, James W., ed., The Complete Energy-Saving Home Improvement Guide, Arco Publishing Co., 1976. Adapted by Ed Lisk in EARTHWATCH, Vol. II, ACES, New Haven, 1978. Drawing: Cecelia Zych

## Objective

The student will be able to:

1. evaluate the need for or use of several common electrical appliances.

## To The Teacher

One hundred years ago electricity was a novelty, and for today's world is an essential. Staggering amounts of electricity are utilized, and approximately every 10 years, the world's demand for electrical energy doubles. A modern city cannot exist without electricity and petroleum. All aspects of living should not require electricity, but most do.

To date, only two proven advanced methods for commercial production of electricity exist to replace the use of petroleum reserves soon exhausted. One is the burning of fossil fuels, namely coal. Although coal is abundant, there are air pollution problems from burning it and health and environmental hazards from mining it. The other method uses uranium - 235 in a light-water nuclear reactor. Inexpensive nuclear fuel is limited. As more costly ores are exploited, electricity costs escalate and as with strip mining of coal, the same rape of the landscape results.

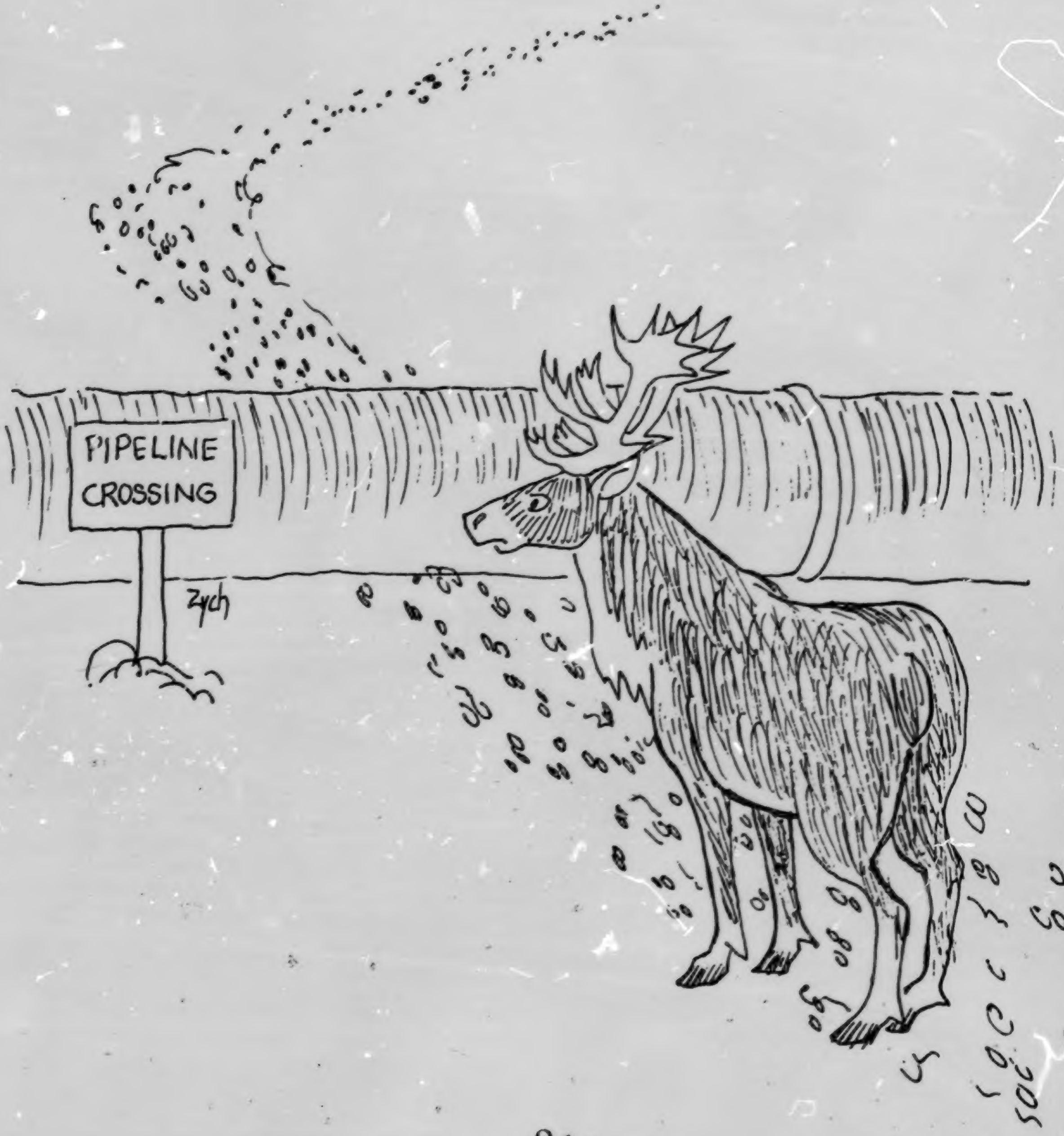
Large-scale alternatives for production of electricity include: the nuclear breeder reactor, nuclear fusion reactor, geothermal energy, solar energy, and coal gasification and liquifaction. The problems involved with all these alternatives are immense.

## Before You Begin

Materials: student worksheets, pencils

## Words To Know

electricity, consumption, high quality life, energy-efficient


PIPELINE CROSSING
Zych

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# ACTIVITY

1. Discuss the use of energy in students' everyday lives. Try to establish people's dependence on electrical appliances.

2. Distribute a copy of the story/worksheet to each student.

3. After the students have finished the worksheet, have them consider the following questions:

   a. Determine which appliances use the most energy and which ones are more energy-efficient.

   b. Could some appliances be eliminated from our lives? Indicate which ones and why?

   c. Consider why we use appliances that can be easily or very easily done without.

   d. Rate all the appliances on the worksheet from 1 to 33 with 1 being the most necessary and 33 being the least necessary.

## Related Activities

1. Determine the approximate cost of electricity for different home appliances.

2. Explore the history and time of introduction of the various electrical appliances.

## Resources

"Oklahoma Energy Awareness Education" (4-12), Oklahoma State Department of Education, 1977

## Credit

Clegg, Peter, New Low Cost Sources of Energy for the Home, Garden Way Publishing, 1975.

Morrison, James W., ed., The Complete Energy-Saving Home Improvement Guide; Arco Publishing Co., 1976.

Drawing: Cecelia Zych

## Notes To Myself

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# STUDENT PAGE

Jim and Pat Kelly are building a cabin in wilderness area in Alaska. They will have no electricity (even though it is available in a near-by town where Mr. Kelly works, but that's the way they want it. They have some strong convictions about living simply. But, there are few people like the Kellys. Many people cannot imagine life without electricity. They consider it absolutely essential to a continued high quality of life. How do you feel about the use of electricity? Place a check in the column which best describes your attitude toward doing without each of the following electrical items:

| | Very Easily | Easily | With Some Difficulty | With Great Difficulty | Impossible |
|---|---|---|---|---|---|
| Radio | | | | | |
| Stereo | | | | | |
| Air conditioning at home | | | | | |
| Air conditioning at work/school | | | | | |
| Dishwasher | | | | | |
| Clothes washer | | | | | |
| Iron | | | | | |
| Electric stove | | | | | |
| Refrigerator | | | | | |
| Lights | | | | | |
| Central heating | | | | | |
| Doorbell | | | | | |
| Ice crusher | | | | | |
| Toaster | | | | | |
| Hair dryer | | | | | |
| Television | | | | | |
| Electric fans | | | | | |
| Clocks | | | | | |
| Vacuum cleaner | | | | | |
| Microwave oven | | | | | |
| Freezer | | | | | |
| Blender | | | | | |
| Electric blanket | | | | | |
| Electric typewriter | | | | | |
| Thermostatic controlled furnace | | | | | |
| Electric can opener | | | | | |
| Telephone | | | | | |
| Electric toothbrush | | | | | |
| Electric frying pan | | | | | |
| Water heater | | | | | |
| Garbage disposal | | | | | |
| Trash compactor | | | | | |
| Power tools | | | | | |

# Energy Menu

## Curriculum Topic

Economics

## Energy Topic

Energy and Economics
Energy Conservation

## Grade Level(s)

6

## Site

Classroom

## Skills

Analyzing information, identifying alternatives, identifying consequences of alternatives.

**Credit** "Energy Conservation in the Home," Univ. of Tennessee Environment Ctr. and College of Home Economics, 1977. Adapted by Pat Krukowski in EARTHWATCH, Vol. II, EEC, Area Coop. Educational Services, New Haven, CT, 1978.

## Objective

Students will be able to:

1. contrast the equivalent energy costs of different foods.
2. List how wise food choices can save energy.

## To The Teacher

The American food industry depends on large quantities of energy to produce, process, transport, store, and prepare enormous varieties of foods. As a result the nation is running up an "energy deficit".

In 1910 the energy content of food produced in the U.S. was slightly greater than the energy used to grow, process and transport the food. In 1970, however, nine times as much energy was used by the food system than was contained in the food consumed. In other words, by the time the food gets to the dinner table, the total amount of energy already used is many times the energy contained in the food itself.

Several things can be done by the consumer who wishes to conserve energy and thus reduce this energy deficit. The use of energy to produce food lies in the manufacturing and transporting of fertilizer, the manufacturing process itself, maintaining and operating farm equipment. The more steps in the process, the more energy that is consumed by the product. One effort to reduce the number of "energy steps" is to eat vegetable protein rather than animal protein.

Other methods of conservation include choosing fresh foods over foods preserved by canning or especially freezing, which requires a great deal of energy. Products should be chosen which do not have an excessive amount of packaging. Cutting down on disposable containers and purchasing in bulk will save energy. Finally, planning shopping trips to coincide with other necessary errands would eliminate another energy consuming step.

In this activity students will be asked to examine their food preferences comparing energy cost and supermarket cost. They may be surprised to discover that low energy cost items are not always the most economical. For example, fresh string beans, because of higher demand, cost more than most brands of frozen string beans.

## Before You Begin

Materials: Each student will need a copy of the directions, the Energ
Menu, Energy Price List, pencil

## Words To Know

energy cost, bulk

# ACTIVITY

1. Pass out Student Worksheets to each student.
2. Supervise activity and lead discussion after activity is completed
3. Questions for discussion:
    a. Why would all of us benefit by selecting foods on the basis of their energy cost?
    b. If you were to select items from Column 1 again, would your choices be any different?
    c. How difficult would it be for you to select foods that have lower energy costs even if they might not be your first preference? Is it worth the energy savings?
    d. Are low energy cost foods always lower in price at the supermarket? Can you offer any explanations?

## Related Activities

1. You might want to discuss with students other low energy cost food items and plan a day's or a week's menu keeping energy cost as your main consideration.

## Resources

"Energy Conservation in the Home", An Energy Education/Conservation Curriculum Guide for Home Economics Teachers, University of Tennessee Environment Center and College of Home Economics, 1977

# STUDENT PAGE

DIRECTIONS FOR STUDENT:

1. READ THE MENU AND CHOOSE ITEMS BASED ONLY ON YOUR LIKES AND DISLIKES. INDICATE YOUR CHOICE IN COLUMN 1.
2. NOW USING THE SAME MENU, TRY TO SELECT THE ITEMS THAT WOULD TAKE THE LEAST ENERGY TO PRODUCE. THE ENERGY COST OF A FOOD INCLUDES FERTILIZERS, INSECTICIDES, EQUIPMENT, TRANSPORTATION, PROCESSING, PACKAGING, AND PREPARATION. PLACE A CHECK AFTER THE LOWEST ENERGY ITEM ACCORDING TO YOUR ESTIMATION IN COLUMN 2.
3. EXAMINE THE ENERGY PRICE LIST TO FIND EACH ITEM'S ACTUAL ENERGY COST. INDICATE ON YOUR MENU THE PRICE OF EACH ITEM YOU SELECTED IN COLUMN 1 AND ADD UP YOUR TOTAL BILL.
4. NOW FILL IN THE PRICE OF EACH ITEM THAT YOU SELECTED IN COLUMN 2 AND ADD UP THE TOTAL BILL.
5. TO DISCOVER HOW MUCH ENERGY YOU SAVED BY CONSIDERING THE ENERGY COST, CALCULATE THE DIFFERENCE BETWEEN THE TWO TOTALS.
6. AS AN OUTSIDE PROJECT, TAKE THE ENERGY PRICE LIST TO YOUR LOCAL MARKET AND WRITE DOWN ITS SUPERMARKET COST NEXT TO ITS ENERGY COST.

# ENERGY MENU

| | Likes and Dislikes | | Least Energy | |
|---|---|---|---|---|
| | check here | energy cost | check here | energy cost |
| Appetizers<br>(choose one from each pair) | | | | |
| Frozen Juice | | | | |
| Fresh Juice | | | | |
| Crackers unwrapped (available in bulk) | | | | |
| Crackers wrapped individually, packed in small cartons | | | | |
| Butter | | | | |
| Margarine | | | | |
| Main Dish<br>(please make a first and second choice) | | | | |
| Luncheon Meat | | | | |
| Chicken | | | | |
| Turkey | | | | |
| Rue with vegetables | | | | |
| Beef (grass-fed) | | | | |
| Beef (grain fed) | | | | |
| Vegetables<br>(we have only carrots, but choose the type you like) | | | | |
| Fresh Carrots | | | | |
| Dehydrated Carrots | | | | |
| Frozen Carrots | | | | |
| Canned Carrots | | | | |
| Drink<br>(please indicate two choices) | | | | |
| Soft drink in aluminum cans | | | | |
| Soft drink in returnable glass bottle | | | | |
| Milk | | | | |
| Beer in aluminum can | | | | |
| Beer in glass bottle | | | | |
| Dessert<br>(choose one) | | | | |
| Apples (fresh from the nearby orchard) | | | | |
| Apples (store-bought) | | | | |
| Shelled walnuts | | | | |
| Unshelled walnuts | | | | |
| Ice Cream | | | | |
| TOTAL BILL | | | | |
| Difference in energy cost: | | | | |

# ENERGY PRICE LIST-1978

(Prices are proportional to actual energy used)

| Appetizers | | Explanation |
|---|---|---|
| Fresh Juice | $.12 | Freezing and processing use a large amount of energy. |
| Frozen Juice | .40 | |
| Unwrapped Cracker | .10 | Food wrapped individually or in small packages uses more energy than food that is unwrapped and available in bulk (large quantities). |
| Wrapped Cracker | .15 | |
| Butter | .15 | |
| Margarine | .05 | |
| **Main Dish** | | |
| Luncheon Meat | 1.60 | A pound of meat requires about four times the energy to produce and market as a pound of vegetable protein. |
| Chicken | .96 | |
| Turkey | 1.06 | |
| Rice & Vegetable | .45 | |
| Beef (grass-fed) | 1.48 | |
| Beed (grain-fed) | 2.08 | |
| **Vegetable** | | |
| Fresh Carrots | .12 | Processed vegetables require more energy than fresh vegetables. Freezing and dehydration requires large amounts of energy. |
| Dehydrated Carrots | .92 | |
| Frozen Carrots | .31 | |
| Canned Carrots | .23 | |
| **Drinks** | | |
| Soft drink (aluminum can) | .45 | Disposable containers consume more energy than containers that are recycled. |
| Soft drink (returnable bottle) | .31 | |
| Milk | .34 | |
| Beer (aluminum can) | .50 | |
| Beer (returnable bottle) | .25 | |
| **Dessert** | | |
| Orchard apple | .03 | Locally grown apple saves transportation. |
| Store-bought apple | .19 | |
| Shelled walnuts | 1.04 | |
| Unshelled walnuts | .39 | |
| Ice Cream | .60 | Freezing is required |

# Saving Through Carpool Participation

## Curriculum Topic

Economics
Citizenship

## Energy Topic

Energy and Economics
Energy Conservation

## Grade Level(s)

6

## Site

Home and Classroom

## Skills

Computing

**Credit** "Gas Watchers Guide," American Automobile Associatio Falls Church, VA. Adapted by Paul Kubicza in EARTHWATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT, 1978.

## Objective

The student will be able to:

1. calculate the achievable financial savings of participating in a carpool.

## To The Teacher

In 1978, approximately 58 million American workers traveled via automobile each day to and from work. Of this group, forty million American workers drove alone. With this many commuters driving an average of 94 miles per week, 290 million gallons of gasoline are consumed. Commuting constitutes the largest single category of automobile usage today.

Carpools provide an efficient mode of transportation while conserving resources and money. Incentives for participation in a carpool include toll discounts, company organized carpools, and special express lanes for multi-passenger vehicles.

The cost of driving an automobile is the result of many factors including depreciation, repairs, maintenance, parts, tires, gasoline, oil, insurance, federal taxes, state taxes, parking costs and highway tolls.

This activity will allow the student to examine the cost of driving a car and to calculate the savings gained through participation in a carpool.

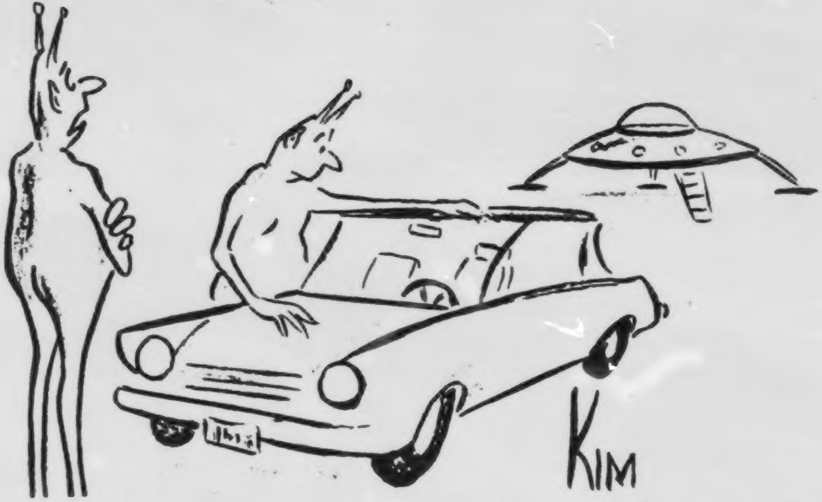
## Before You Begin

Preparation: Prepare classroom copies of:

1. The Cost of Driving a Car
2. How to Compute Commuting Costs
3. Commuting Costs Worksheet

## Words To Know

carpooling, depreciation, maintenance, accessories



"Judging from the amount of noxious gases it emits, I'd say it's some type of weapon."

Conservation News 2-15-78

# ACTIVITY

1. Distribute copies of "The Cost of Driving a Car" to the class.

2. Calculate the cost per mile of driving a car by adding the expenses of depreciation, maintenance, accessories, parts and tires, gas, oil, insurance, and taxes.

3. Distribute copies of "How to Compute Commuting Costs" to the class. Calculate an example with the class.

4. Distribute copies of "Commuting Costs Worksheet". Allow students to take the worksheet home to determine their parent's commuting costs. (This assignment may require several days if parents have never calculated the distance to work before.) For students with non-working parents, calculate the distance to a hypothetical site.

5. Complete the activity by examining the savings provided by a carpool. Below are sample discussion questions:

   a. Is a carpool a desirable way to save money?

   b. What are some of the problems in organizing a carpool?

   c. What are the problems members of a carpool may experience?

   d. Is a carpool beneficial to our economy?

   e. What effects do carpools have on air pollution and gasoline consumption?

## Related Activities

1. Students may write to the U.S. Department of Transportation or Connecticut Department of Transportation for information on carpool participation.

2. Students may determine the cost of traveling to the grocery store, beach, gas station, movies, relatives' or friends' houses, etc.

3. Discuss the effects of inflation and increasing energy costs on the cost of driving a car. Determine the annual savings per person of carpool participation.

## Resources

"1977 Gas Mileage Guide", U.S. Environmental Protection Agency, Washington, DC.

"Save by Carpooling", American Lung Association.

## Credit

"Gas Watchers Guide", American Automobile Association, Falls Chruch, VA.

"Ideas and Activities for Teaching Energy Conservation: Grades 7-12" Environment Center, University of Tennessee, 1977

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# STUDENT PAGE

## HOW TO COMPUTE COMMUTING COSTS

EXAMPLE: FIGURE THE COMMUTING COSTS OF A STANDARD SIZED CAR TRAVELING 30 MILES ROUND TRIP TO A WORK SITE.

1. MULTIPLY COST PER MILE X MILES PER DAY: .17 x 30 = $5.10
2. ADD DAILY PARKING AND TOLLS = +0
3. TOTAL DAILY COST = $5.10
4. MULTIPLY BY WORKING DAYS IN A MONTH x 20
5. COST PER MONTH TO DRIVE ALONE = $102
6. DIVIDE BY NUMBER OF PEOPLE IN CARPOOL ÷ 4
7. INDIVIDUAL COST BY CARPOOLING = $25.50
8. MONTHLY CARPOOL SAVING ($102 - $25.50) = $76.50

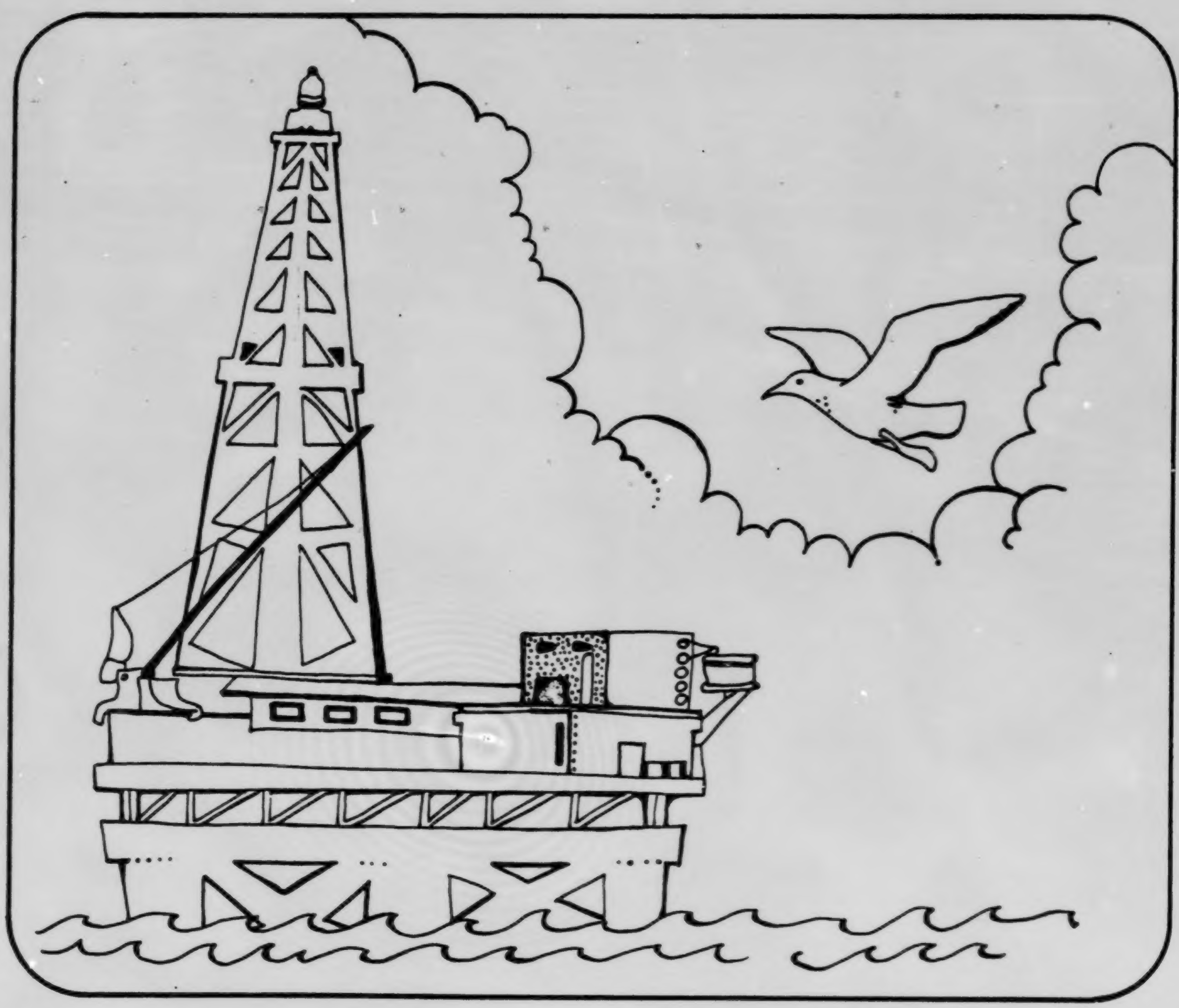
## COMMUTING COSTS WORKSHEET

1. MULTIPLY ________________ (COST PER MILE) X ________________ (MILES PER DAY) = $
2. ADD ____________ (PARKING COST) + ____________ (TOLLS) + $
3. TOTAL DAILY COST = $
4. MULTIPLY BY WORK DAYS PER MONTH X
5. COST PER MONTH TO DRIVE ALONE = $
6. DIVIDE BY NUMBER OF PEOPLE IN CARPOOL ÷
7. INDIVIDUAL COST OF CARPOOLING = $
8. MONTHLY CARPOOL SAVINGS (#5 - #7) = $

## THE COST OF DRIVING A CAR (PER MILE) 1978

| Car Size | Depreciation | Maintenance, Accessories, Parts, Tires | Gas, Oil | Insurance | State and Federal Taxes | Total Cost (Per Mile) |
|---|---|---|---|---|---|---|
| Standard | 4.5¢ | 3.7¢ | 5.5¢ | 1.7¢ | 1.6¢ | = 17¢ |
| Intermediate | 4.2¢ | 3.4¢ | 5.3¢ | 1.6¢ | 1.5¢ | = 16¢ |
| Compact | 2.9¢ | 2.7¢ | 4.7¢ | 1.5¢ | 1.2¢ | = 13¢ |
| Subcompact | 2.3¢ | 2.5¢ | 3.8¢ | 1.5¢ | 0.9¢ | = 11¢ |

# ENERGY AND THE ENVIRONMENT



## ENERGY AND THE ENVIRONMENT

ACTIVITY TITLE ........ PAGE NUMBER

THE BEST PRESENT OF ALL....................................207

DANGER: UNFIT FOR HUMAN USE.............................213

CLAY TANKERS...............................................222

ENERGY CHAIN...............................................227

NEW ENERGY RESOURCES......................................231

# ENERGY AND ENVIRONMENT

One of the most important lessons of ecology is that "everything is connected to everything else." Nowhere is this lesson more convincingly taught than in the overlap between Energy Issues and the Environmental Issues.

If we begin our study with energy, and worry about the inability of supply to meet demand, we are immediately told that obstruction by "environmentalists" has slowed down the construction of generating plants (coal burning as well as nuclear) as well as oil refineries. Pointed to are delay of the Alaskan pipeline, the moratorium on offshore oil production in the Pacific, and attempts to restrict strip mining for coal. We are also warned of the need for much more energy to repair past damage to the environment and to safeguard its future.

If we enter the question by way of the environment we come immediately to energy. Air pollution is, for the most part, a problem caused by energy consumption. Most of the harmful chemicals in smog come either from the fossil-fuel generating plants or the automobile. The production and transportation of energy are responsible for strip mining, oil spills, and the "aesthetic pollution" of transmission lines. Energy consumption also causes "heat pollution" of our rivers and of our cities' air and is behind the new threat of radioactive pollution.

Whatever our approach, whether environmental protection or energy consumption, it is clear that energy and environment cannot be studied separately. One focus is on the environmental effects of "production" of energy, its extraction from primary sources.

There are measurable environmental costs of extracting energy from primary sources. These are most obvious in the case of coal where our experience is most complete. The choice seems to be between strip mining, which has already overturned some 2,400 square miles of land leaving much of it ruined, and underground mining, which causes cave-ins and ruins streams with its acidic drainage. Coal mining, especially underground mining, also extracts a price from the miners. It is among the most dangerous occupations and injury and disease must be counted in coal's cost.

There are also environmental costs of extracting energy in other forms. Several future sources carry warning signs. If we turn to the oil shales for energy, we will be entering a mining operation larger than the one for coal. Oil shale has only about one-seventh the energy per ton of coal and most of the shale becomes waste rock to be disposed of. Oil shale is also a prime example of the continuing problem of turning relatively wild areas into mining and producing sites.

In turning offshore and to the Arctic for oil we are threatening a much more delicate environment than did pumping oil from the soil of Texas, Louisiana, or California. The shallow coastal regions can be seriously damaged by oil and the Alaskan tundra is threatened by all the activity taking place on it--in particular the chance that oil spills on the ice might bring changes in climate.

Energy, unlike money, draws no interest when it sits unused. To obtain value from it we must deliver it to a customer. In some cases, the means for delivery have important environmental effects.

Energy is shipped in several ways. Oil and gas travel by pipeline across this country and oil is moved in larger and larger quantity by tanker from foreign sources. Coal travels primarily by rail, electricity by wire. Transportation also has its environmental costs. The major concerns focus on the transport of oil and of nuclear materials.

Oil transportation has environmental impact in several ways. The most dramatic is through the danger of massive oil spills from the large tankers. These supertankers now carry hundreds of millions of gallons of oil as contrasted with the 29 million gallons spilled from the Torrey Canyon off the coast of England several years ago. As our importation of oil increases we will need the equivalent of three or four of these tankers per day unloading at our ports.

Oil tanker spills are the most dramatic, but the dumping of oily ballast water in routine operations causes five times the contamination of all oil accidents combined. If we are to preserve our vulnerable shallow coastal waters, we must find ways to cut down the spillage from all forms of oil transportation near our shorelines.

If spills are the most dramatic danger, the transportation of oil across Alaska by pipeline has been the most politically sensitive one. The TransAlaskan pipeline, recently constructed now carries 2 or 3 million barrels of oil per day from the rich North Slope oil fields to the southern port of Valdez. The effect of the heated pipeline on the delicate tundra with its underlying permafrost is a cause of concern as is the danger of breakage from earthquakes. The pipeline also cuts across the migration paths of the caribou and its effect on them will bear watching.

Transportation of nuclear materials is increasing rapidly. There were almost 4,000 shipments of fuel and waste materials within this country in 1974 and the number grows with the growth of the nuclear industry. While great precautions have been taken to keep the materials safely encased, the results of spillage are sufficiently serious to warrant continual surveillance.

The growing role of plutonium as a nuclear fuel introduces a new worry. This material is being shipped and stored in a form from which nuclear bombs could be constructed. Since even a crude bomb of 40 or 50 pounds could do enormous damage and since plutonium production by the end of this decade will be measured in tons-per-year (28 tons per year in 1980), we must develop a much more sophisticated security system than we have at present if we are to make major fuel use of this material.

These hazards of the transport of oil and nuclear materials are joined by the land use problems of transmission lines and the worry over the thousands of miles of gas pipe under our cities.

A working energy policy for the future must weigh the environmental costs of energy transportation along with other environmental effects and against the end uses of that energy.

In addition to the environmental effects of producing energy in its various forms and delivering it to consumers, there is also the environmental impact at the end of the flow pattern.

It is here, of course, that we use energy to our great benefit, to warm our homes and offices, provide transportation, and power the many engines and processes of industry. It is also here, at the consuming end, that we see, smell, and feel some of energy's most obvious environmental impacts.

The major environmental effects of energy consumption fall into three broad categories: air pollution, heat pollution, and nuclear energy hazards. From a different point of view, we could use two other headings--the environmental effects of electricity generation and of automobile use. The generation of electricity claims a share of all three pollution categories, while the automobile owns much of the air pollution category.

In a discussion of air pollution, the presence of 75 percent of the carbon monoxide, 53 percent of the hydrocarbons, and 47 percent of the nitrogen oxides is attributed to the automobile; and 73 percent of the sulfur oxides plus 42 percent of the nitrogen oxides to the fossil fuel burning power plants. Of the fossil fuels, coal is the chief offender.

Electric power generation is responsible for most of the cooling water demand, 85 percent of the total. It may use as much as one-sixth our total average fresh water run-off by 1990. The switch to the nuclear reactor will not help here, as it demands more water than the fossil fuel plants.

The nuclear power plants are newer on the scene, but they have not come quietly. There has been much protest and concern. Environmentally, criticism has had three foci: radioactive pollution, radioactive waste, and the danger of nuclear accident. Recently a concern of the threat of plutonium in the lungs has been added. As is often the case, these controversies continue strong because scientific data are lacking. Nuclear energy is too briefly with us. In most of the specific instances, however, concern is over statistically improbable but individually large effects. The pro and anti-nuclear positions usually involve more than the effects themselves. They are based on a complete and often hidden personal risk judgment. This is as it should be. Education has the important task of facilitating the making of these and related judgments.[1]

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[1] Largely based on The Energy-Environment Source Book, John M. Fowler, National Science Teachers Association, 1975.

# THE BEST PRESENT OF ALL

## Curriculum Topic

Dramatic Expression
Heat

## Energy Topic

Energy Sources
Energy and the Environment

## Grade Level(s)

K-2

## Site

Classroom or stage

## Skills

Listening with comprehension, identifying alternatives, concluding, group skills.

**Credit** "The Best Present of All" in Ranger Rick's Nature Magazine, National Wildlife Federation. Adapted by Wendy & Harold Carter in Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Dept. of Energy, Technical Information Center, Oak Ridge, TN, 1977

## Objective

Students should be able to:

1. Make and/or decorate a simple costume or scene to use for the play.
2. Take part in acting out an energy story.
3. Apply what they learned in the story setting to what is the case in real life.

## To The Teacher

In attempting to meet the world's energy needs now and in the future, mankind has several options. This activity focuses on the positive aspects of solar energy as a source that can meet the world's energy needs with a minimal impact on the environment. Through the reading and enactment of a dramatic play, students will learn about the sun and other forms of energy and compare the positive and negative factors involved in their use.

## Before You Begin

You will need the following materials:

(These may be as simple or as complicated as you wish.)

Roll of art paper or brown paper bags
Magic marker
Crayons
Collage-type materials stapled or taped together

## Words To Know

Oil, gas, coal, atom, geothermal, sun

## Notes To Myself

230

# ACTIVITY

1. This is a narrative which can be read to your class first as a story to be enjoyed. Then you might want to invite another class in to see it.

Discuss the various characters and make plans for acting out the story as it is narrated. You will need the following characters (listed according to order of their appearance):

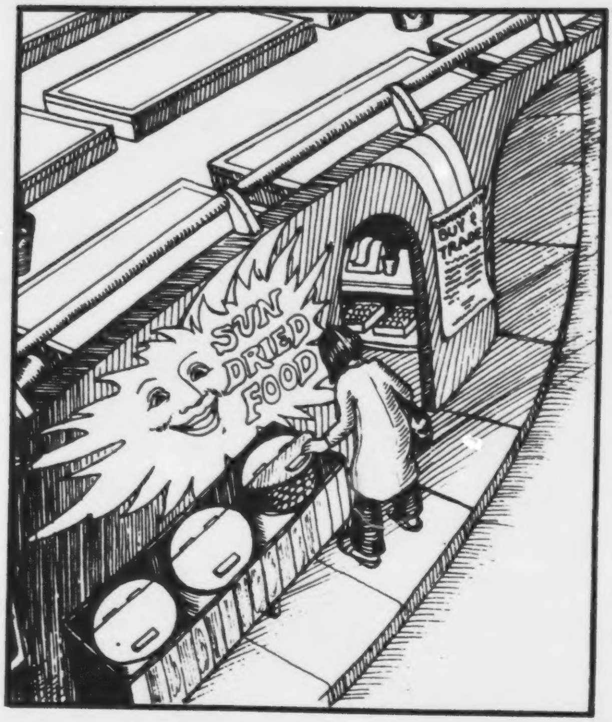
King Oliver
Wise Men
Page Boy
Mr. Oil
Mr. Gas
Mr. Coal
Mr. Atom
General Water
Mr. Geothermal
The Golden Sun

2. You can extend the list by including people of the court. Some children might be used as stage hands to decorate and set up the throne. If you end the story with the King giving lollipops to the court, you might have a committee in charge of distribution. Try to involve everyone in the class in some way. Some might even be the artists who make posters to advertise the play.

3. At some time after the play, review what they have learned from the story. Ask the children what materials can be used to produce heat and light energy. Discuss the pros and cons of each form of energy. This should be kept simple but they may pick up more than you expect; some from the play, others from TV or class discussions. These may be among the things mentioned:

| Form of Energy | Good About It | Not Good About It |
|---|---|---|
| Oil | Easy to transport | Expensive, scarce<br>May leak and spill<br>Gasoline causes air pollution |
| Gas | Clean | Expensive<br>Limited supply |
| Coal | More available | Pollutes the air<br>May spoil the environment (strip mining) |
| Atoms | Available<br>Clean | Poisonous waste |
| Water | Clean | May spoil rivers and streams<br>Not enough available |
| Geothermal | Clean<br>No poisonous waste | Available only in limited places |
| Sun/Wind | Unlimited amount available<br>Doesn't spoil the environment | Presently expensive |

Note: This is in no way meant to be a complete list, nor would you expect your class to pick up many of these. Any that they get are a plus for energy education.


SUN DRIED FOOD
BUY & TRADE

# STUDENT PAGE

## THE BEST PRESENT OF ALL

This is a story about King Oliver who lived in a cold dark castle. Because he loved the children in his land he invited them to come to a wonderful party with ice cream and cookies and lollipops to eat. King Oliver wanted his party for the children to be extra-special-special. He wanted to give the children "the best present of all" -- a present for all their lives and all their children's lives, too -- a present for forever.

King Oliver asked his wise men to help him. They sat in the cold dark castle and shivered as they tried to think of a special present. A page boy with them wished out loud to be warm and his wish gave the King the idea that he could give his children warmth and light forever.

One of the wise men told the King that a fire would boil water and make steam to warm the castle and turn a motor to make the lights work. The problem would be to find enough fuel. The wise men made a list of things that can be used to produce energy.

The King invited all of the energy sources to the castle.

Mr. Oil and Mr. Gas came in together to talk with the King. Mr. Oil was large and messy and left oily footprints when he walked. Mr. Gas was small and timid. He was very neat and clean looking.

The King asked them how they could make energy for his children's homes.

Mr. Oil told the King that he was really very clean. It was because there were so many cars that there was air pollution. Mr. Gas also said that he would burn clean. Both admitted that they would not last very long because when they are burned they are all gone. The King sent them away because his present had to last forever; and they would not.

Mr. Coal came in next. He was a giant, covered with black stones and leaving dirty dusty puffs of coal when he walked.

He told the King that he could not burn clean. Little pieces would get into the air and in people's clothes and lungs although there was plenty to last a long time. All that had to be done was to push away the grass and trees and dig the coal up.

The King sent Mr. Coal away too. He did not want his children to have dirty air or lose their trees and grass.

The King saw Mr. Atom next. He was a very shiny neat man who bounced when he walked.

Mr. Atom explained how he could split and make energy. He said he got very, very hot and was full of energy. He did have a problem with a poison called radioactivity but could keep the poison in a box. If the King could find a place to put the box for a very long time, the poison would be all gone.

Sadly King Oliver sent away Mr. Atom. The King did not want his children to have to worry about poison.

General Water marched into the room and saluted to everyone. He would flood the valleys and rivers and make a dam, he told the King. That dam would give the King some energy for heat and light. He did not want to lose his valleys and mountains, so the King told General Water goodbye.

The King was feeling very sad. He wanted a good source of energy that would not destroy the land or hurt his children.

The wise men brought Mr. Geothermal to the King. Mr. Geothermal was very round and clean and he puffed and huffed when he walked.

This time the King heard about a good kind of energy that would use the heat already inside the earth to warm homes and turn motors. He could be pumped out of the earth, Mr. Geothermal told everyone in his puffy voice, and the land did not have to be destroyed. King Oliver was happy. He asked Mr. Geothermal to sit beside him. He wanted to talk with him some more.

Suddenly the room was filled with warmth and light. Before them stood the golden sun. She was like a beautiful golden butterfly. Her dress shone like a thousand golden coins and when she smiled all the room was warm.

The golden sun told the King that her energy made plants and people grow. She said her warmth could be caught in a basket of stones and let out at night to warm a house. She could make the wind blow to make electricity. If the King would build his houses to catch the sun, and make windmills, then his children could have warmth and light forever -- because she would be there forever to serve them. Then the golden sun left the King's castle to visit the other side of the earth.

The King spread his arms wide. He smiled a happy smile. He had a wonderfully good present for his children -- warmth and light from the earth and the sun. And guess what else? Ice cream and cookies and lollipops!

# DANGER: UNFIT FOR HUMAN USE

## Curriculum Topic

Transportation

The City

## Grade Level(s)

3-4

## Site

Classroom, community, home

## Skills

Collecting and compiling data, interpreting data, infering from data, recognizing problems, developing a plan of action.

## Energy Topic

Energy and the Environment

## Credit

Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy, U.S. Department of Energy, Technical Information Center, Oak Ridge, TN 1977.

## Objective

Students should be able to:

1. Record information in chart form.
2. State at least one cause of pollution by transportation vehicles on land, water and air.
3. State at least three methods of controlling or reducing pollution.

## To The Teacher

The problem of pollution has cost a great deal in terms of the damage to health, effects on materials (rust and corrosion, repainting, the cost of protective coatings), damage to residential properties (reduction of values by pollution), and damage to vegetation. At the present time most of these costs are being borne by the public.

The exhaust from automobiles and other vehicles of transportation are major contributors to the problem of air pollution. Two of the pollutants emitted from exhaust are lead and carbon monoxide. Cars also provide the ingredients for the smog that bothers your eyes and nose on hot, still days in the summer.

Noise is just as much an air pollutant as dust and smoke because it is harmful to man in his environment, for example: the noises of a great city - traffic, sirens, horns.

The sound level in front of a rock band has been measured as 120 decibels. A noise level of 100 decibels can kill small animals!

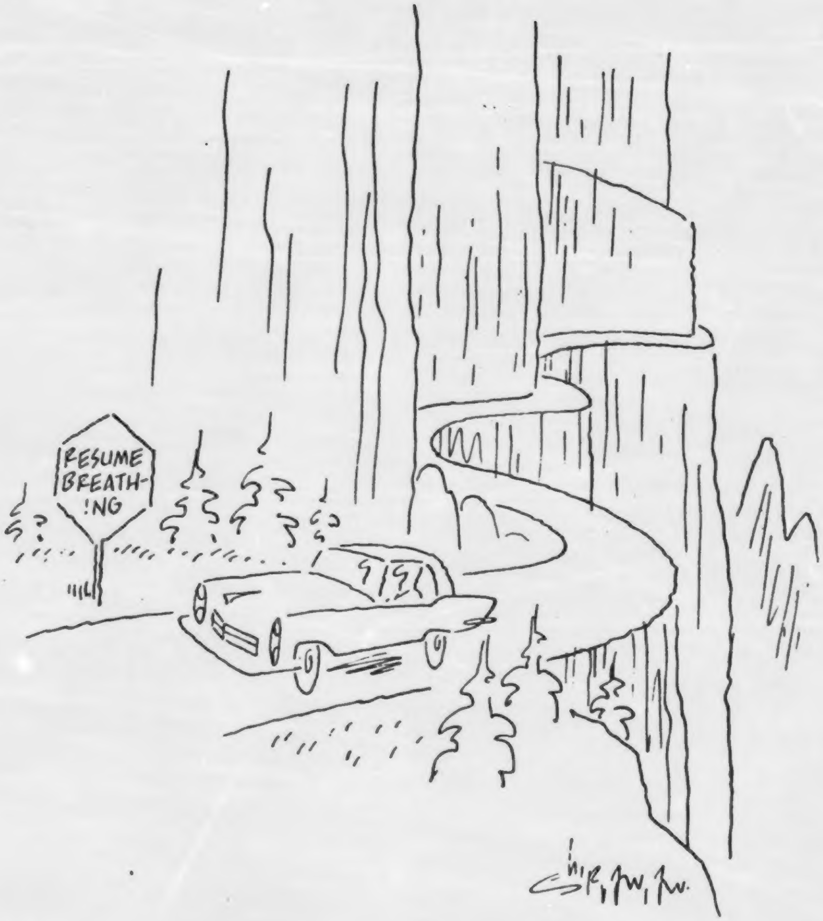
## Before You Begin

You will need to provide the following materials:

- Three 3" x 5" index cards per student
- Vaseline
- Copies of Student Pages, Life in the City, Airport, What Happened Here, and "An Airplane in My Living Room"

## Words To Know

Pollution, exhaust



Audobon, May, 1976

# ACTIVITY

1. Distribute copies of Life in the City and ask:

"What kind of pollutants could you see?"
(Exhaust fumes, smog, crowded traffic, litter, etc.)

"What kind of pollutants could you smell?"
(Exhaust fumes, smog, etc.)

"Which kind could you feel?"
(Heat, chemicals which irrate the skin, etc.)

"What is causing most of these pollutants?"
(Cars or burning gasoline in engines of cars, busses, etc.)

"Is there any way that we could improve the situation in the city and eliminate some of the pollution?" (List ideas on board. Possible responses: More people use busses or other public transportation, use electric cars, have bicycle paths, reduce exhaust fumes, fine people for littering, etc.)

2. Continue lesson by telling students that they can become pollution detectives and find out how much pollution is in their community. Distribute three 3" x 5" cards to each student. Tell them that they may choose three places in their community to test the amount of pollution. Places may include shopping center, factory, highway gas station, home, park, school, etc. Have each student write his/her name and the place he/she is testing on one side of the card and cover the other side with vaseline. They will place the cards in such a manner that they will not blow away. After two days, they will collect the cards and look at what has happened to them.

3. After the assignment is completed, have students place their pollution cards on the desk and have students examine them carefully. Note degree of discoloration and texture of vaseline. Group cards according to the amount of discoloration. Record places on the board using chart.

Pollution in Our Community

Heavy
Medium (Names of places)
Light

Ask: "What do you think caused the pollution? Where are most of the places with 'heavy pollution' located? 'Light pollution'?" "Which areas have the cleanest air?"

4. Distribute copies of Airport. Ask students to examine the picture and ask:

"Are there any pollutants that you could see? Hear? Smell? Feel?" (Possible responses: jet exhaust, sound of engine, general noise, heat from engines, etc.)

"What is causing this pollution?" (Running of engines, sound of engine, burning of fuel, etc.)

"Are most airports located inside the city or outside? (Outside.) Why do you think planners do this?"

"Do you think people like to live near an airport? Why or why not?"

"Where is our nearest airport located?" (Locate on local map.)

"Have the people in our community ever had problems with the airport?"

"Have you ever heard of people in other places complain about airplanes or an airport?" (Possible responses: the Concord noise problem in New York and Washington, DC.)

"What can be done about the pollutants caused by airplanes?" (List responses on the board. Possible responses: reduce noise of engines, locate airports in non-residential areas, reduce jet exhaust, etc.)

"Let's read a story about a boy who lived near an airport and see how he felt about it."

5. Distribute copies of An Airplane in My Living Room and select several students to read sections aloud while others read silently. (Possible responses to the question asked in the story.)

1. What caused the sound of the jet to become louder?
2. Why does the noise from the airplane make my ears hurt?
3. Does the pollution hurt plants too?

6. Briefly discuss the story by asking:

"What types of pollution bothered Gary?" (Noise and exhaust fumes.)

"Do you think Gary lives near an airport? Why or why not?"

"What is a vibration? (Vibration is back and forth movement.) Have you ever seen anything vibrate?" (Guitars and other musical instruments, engines, etc.)

7. "Let's look at a picture, What Happened Here? and see if we can find examples of how water is polluted."

Distribute copies of What Happened Here? and have students name the pollutants as you record them on the board. (Possible responses: oil leak, fish and birds covered with oil, people littering from boats, beach is polluted by oil and ruined for swimming. etc.)

"If this happened to your favorite beach, what could you do to correct the problem?" (List responses.)

8. Put the chart "What Do We Do Now?" on the blackboard without filling in the information. Lead a class discussion in which to ask students to summarize the types of pollution they have learned about and some possible remedies.

WHAT DO WE DO NOW?

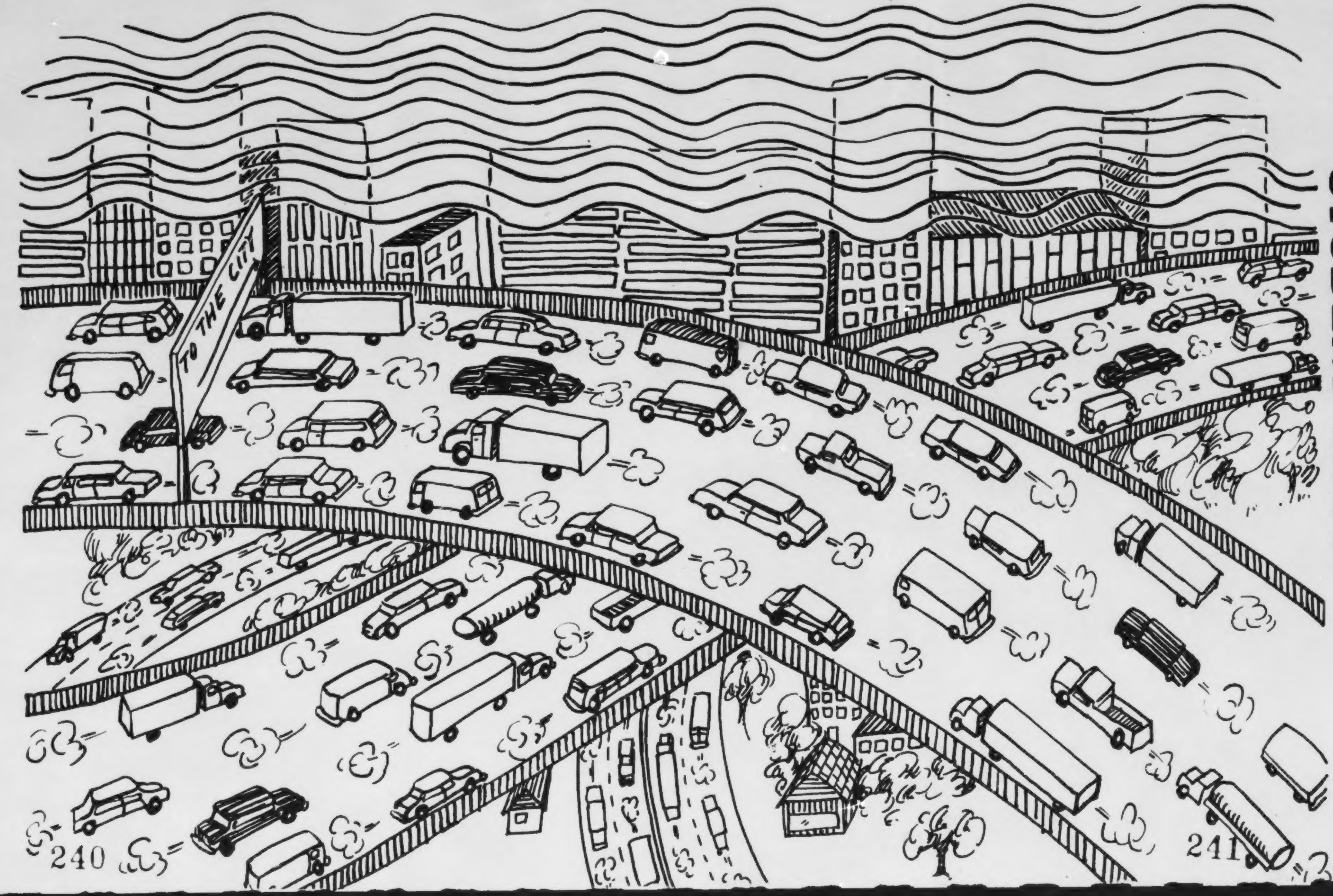
| | Kind of Transportation | Pollution | Next Step |
|---|---|---|---|
| Land | car<br>motorcycle<br>bus<br>train | exhaust fumes<br>noise<br>litter | better engines<br>fines for littering<br>inform people of problems of littering |
| Air | airplanes<br>helicopters<br>private planes | exhaust fumes<br>noise | location of airports<br>better engines<br>control of exhaust |

| | Kind of Transportation | Pollution | Next Step |
|---|---|---|---|
| Water | ships<br>oil tankers<br>submarines<br>pleasure boats<br>sailboats | oil spills<br>exhaust fumes<br>noise<br>spoiled beaches | better tankers for moving oil<br>quieter engines<br>fines for spoiling beaches |

## Related Activities

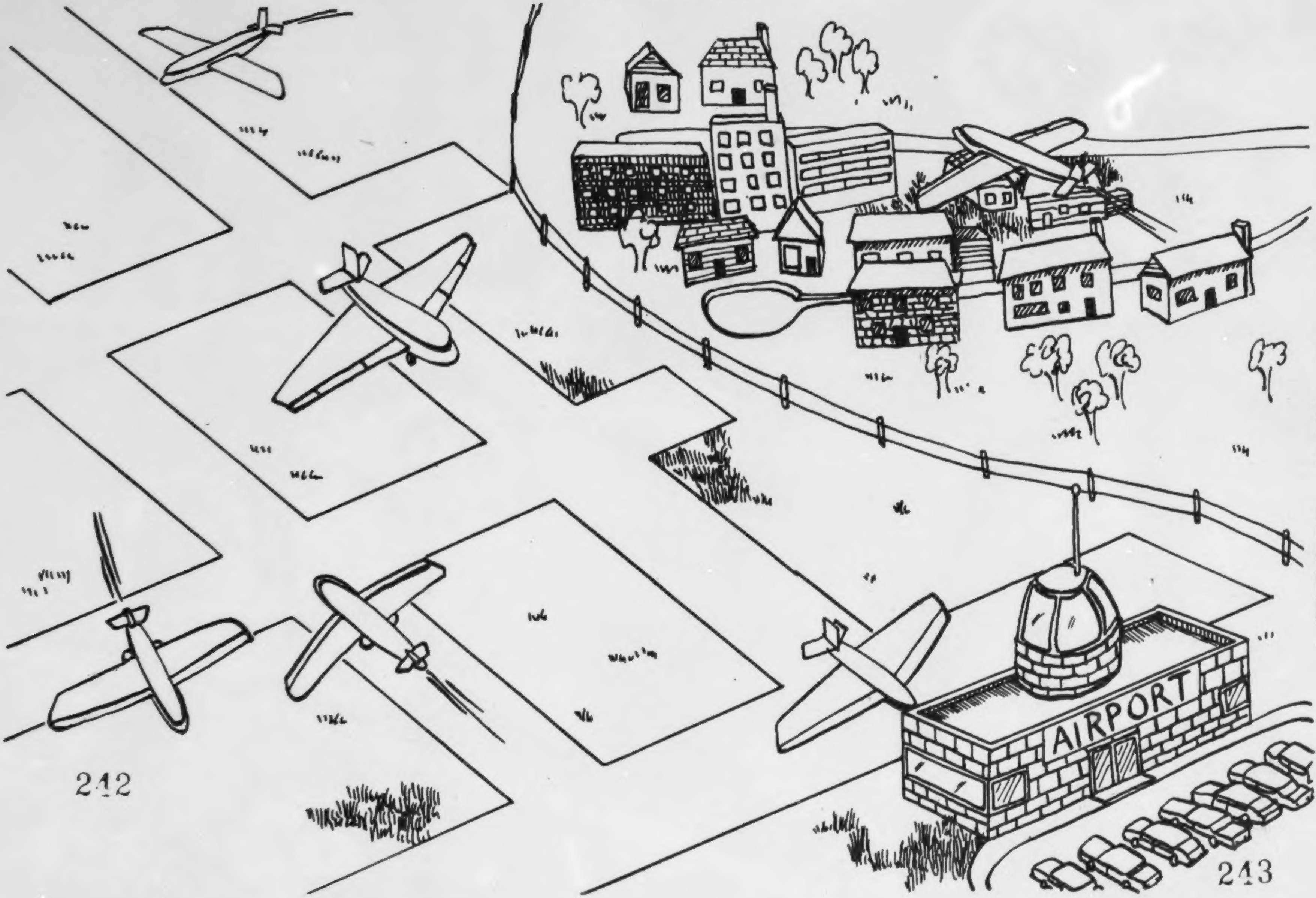
1. Take a field trip if possible to the closest airport to see a plane land and take off. Take along a portable tape recorder just to record the sound. Play it back later. Would we mind hearing this sound all day long?

# LIFE IN THE CITY



STUDENT PAGE

# AIRPORT



STUDENT PAGE

# STUDENT PAGE

## An Airplane in My Living Room

Gary was sitting in his living room watching his favorite television program,"Sesame Street". All of a sudden he heard a low pitched hum. It grew louder and louder, and the pitch became higher and higher. R-R-R-R-R-R-Z-O-O-O-M! Finally, it became so loud that Gary could not hear what Big Bird was saying.

Gary went outside to see what was causing the noise. It was a jet plane and it was moving very fast!

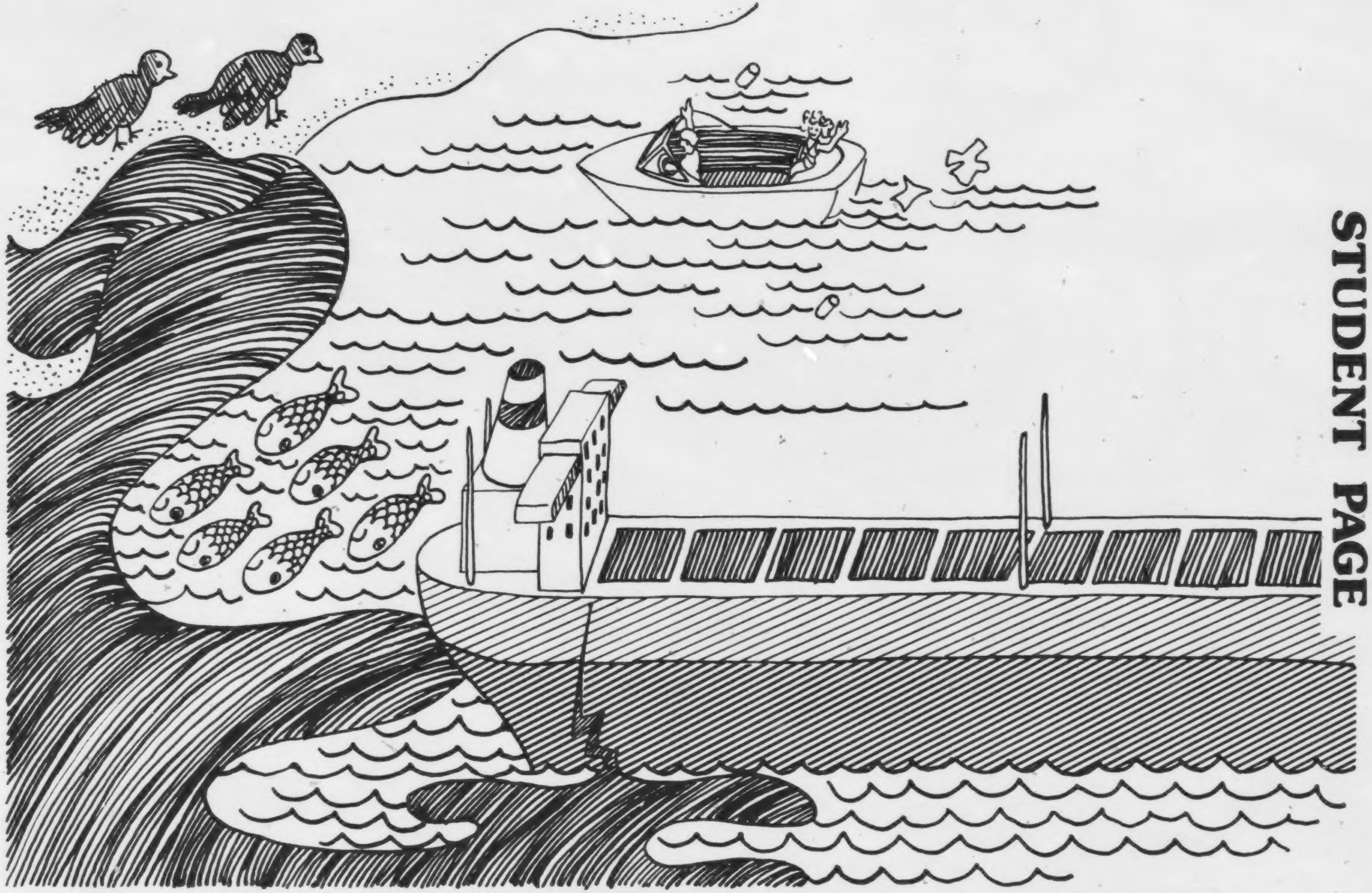
"Jets sure make a lot of noise!" said Gary.

Gary observed many things about the jet. He could see the smoke from the engine, also he could smell the smoke. He knew a word that tells what they are called - pollution. He could still feel the vibrations and his ears began to hurt.

When something moves back and forth, it is vibrating. When the engine of a jet is vibrating slowly the sound cannot be heard. But as the engine vibrates faster and faster, the sound becomes louder and louder.

Gary thought about the airplane noise and exhaust smoke for a long time. When he went back to his living room, he wrote down some questions to ask his teacher the next day. What questions do you think he wrote?

# WHAT HAPPENED HERE?



# Clay Tankers

## Curriculum Topic

Shapes that Float
Transportation

## Energy Topic

Energy Sources
Energy and the Environment

## Grade Level(s)

3-4

## Site

Classroom

## Skills

Classifying, observing

**Credit** Steve Gold, in EARTHWATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT 1978.
Illustrations: Ann-Marie Fleming

## Objective

Students will be able to distinguish characteristic shapes of cargo vessels and demonstrate the importance of ballast.

## To The Teacher

In February, 1978, the United States imported over 18 million barrels of crude oil and petroleum products daily, most arriving in tanker ships, which make more than 15,000 calls yearly in the U.S. alone. Increasing tanker traffic has contributed to an alarming number of oil spills in the oceans and rivers of the world - over 10,000 annually. A quarter of spilled oil comes from routine tanker operations rather than spectacular (Argo Merchant, Torrey Canyon) spills. Tankers have grown progressively larger, the largest tankers being 16,000 deadweight tons (volume) at the beginning of World War II, while tankers of three to five hundred thousand tons are common today. Increase in ship size was made feasible by the slower increase of operating costs: since crew size is about the same for all tankers over 35,000 tons, it is less expensive to use one 500,000 ton tanker than two half the size.

The designer of supertankers faces money constraints and the low maneuverability of the tanker itself which may need ten times its own length to stop. The shipbuilder's usual problems - buoyancy, stability and strength - are greater in building ships as long as 1200 feet. Since tankers are only floating tanks, they are, when empty, extremely buoyant. They ride high in the water, and can even flip end over end in rough seas. To lend stability, tankers commonly take on ballast, or stored seawater. Oil residue mixes with this ocean water in the tanks. Eventually, the discharge of ballast in shallow water or near port, to allow loading of the ship, becomes a major cause of oil pollution.

Long-term effects of oil in the ocean are still in debate. Some petroleum is known to contaminate shellfish and major crude spills foul beaches, kill birds, and may contribute to long-term ecological changes of unforeseen consequences.

## Before You Begin

Materials: modeling clay (oil base), metal weight (or penny rolls, iron bars, etc.), basin of water, plastic sandwich bags, cardboard, toothpicks, thumb tacks, marbles (optional),"Tic-Tac" or match boxes

Preparations: Construct from clay hollowed-out, crude models of a container ship, a general cargo ship, and an oil tanker. The attached diagrams show the shapes of vessels. The tanker should be the largest. The clay walls should be as thin as feasible.

The tanker's important characteristics are: broad beam (width), aft (rear) superstructure, with all the remaining space for tanks. It is quite simple to build. Begin with the basic hull shape, which doubles for the tank area of the boat. Add the solid, rectangular superstructure at one end. Tack one or more sandwich bags (you may have to cut them to fit) to the inside walls. These are your tanks. Cardboard, cut to shape and tacked across the top, is your deck. You may have some trouble keeping your boat afloat at first, since it will tend to sink at the heavy end and capsize. To compensate, remove clay from the superstructure or add it to the raised forward part of the deck. The boat should be stable enough to float when empty, but a small weight added to the heavy end should be enough to flip it over. When the tanks are full, 3/4 of the tank area should be below waterline.

The most unique thing about a container ship is that all its cargo is carried on deck in uniformly-sized boxes. To build the container ship, start with the hull shape. Add fore and aft superstructures. The deck can be a layer of clay or heavy cardboard tacked across the hull. Insert toothpicks in rows across the deck to position your containers, which may be empty boxes from "Tic-Tac" candy, matchboxes, or similar containers.

The general cargo ship carries all types of packages in holds below deck. Its hull is narrow at the fore and broad at the aft end. This ship is quite easy to build. Begin with the hull. You might insert vertical pieces of cardboard to divide the ship into several holds. Then, tack on the cardboard deck. About two-thirds of the way to the ship's aft, add a small clay superstructure. Make sure it is light enough to avoid capsizing the boat. If this becomes a real problem, add clay to the walls of the hull in the fore part of the vessel, below deck. Fully laden with an appropriate cargo (pennies or marbles), about half the hull should be below the waterline.
Caution: Always test your models for floatability and cargo capacity in advance. Test the results of demonstrations of ballast ahead of time.

## Words To Know

oil spill, tanker, ballast, supertanker, cargo, container ship

# ACTIVITY

1. When students have completed a unit on clay boats, show them your three models. Display your cargoes (water or vegetable oil, boxes, and marbles) and ask which boat they think would be best to carry each cargo.

2. When the boats have been identified, focus attention on the tanker and point out its major features. Remove the deck and have a student try to put as much water in the tanks as possible without capsizing the boat. Students should observe that the boat rides lower in the water as the tanks are filled.

3. Explain to the students that tankers carry oil from countries like Saudi Arabia to countries like the U.S., traveling across many miles of often rough seas. Empty the tanker and ask what might happen if a large wave were rising on the front of the vessel and falling at the rear: "It might tip over." Demonstrate by placing a metal weight (or bar, or several penny rolls in a plastic bag) on the aft superstructure.

4. Have students suggest ways to keep the ship stable under such conditions. They may suggest ballast of their own accord. Demonstrate that the boat does not tip when weight is added.

5. Discuss ballast and the problem of oil pollution because of ballast discharge. You might ask:

a) Where would a real tanker, empty at sea, get its ballast?

b) Where could the ballast be stored? (oil tanks)

c) What would happen if there were some oil sticking on the walls of the tanks?

d) What would the ship do when it was time to take on oil?

e) What problems could that cause?

f) How could that be avoided? (Clean tanks before taking on ballast; build ships with separate ballast tanks.)

6. Additional discussion questions:

a) Which do you think would cost less, building and using one big tanker or two smaller ones?

b) Why do you think big tankers often have accidents?

c) What do you think happens to sea life if there is a big oil spill?

d) Why do you suppose tankers are not built with separate ballast tanks? ($$$)

## Related Activities

An activity on oil pollution is a good follow-up. Spread vegetable oil in a thin layer atop the water. Find the best way to clean it up. Try spreading shredded paper to absorb it, using clay-sealed plastic straws as booms to contain it, skimming it with a spoon, or spreading detergent on it to try to emulsify it.

A variation of this activity would begin with a challenge to the students to build a boat to hold oil. The teacher would not build boats.

## Resources

On tankers, cargo ships, and their shapes (with photos):

Braynard, F. O., "Ship: Fuel Powered Vessels," *Encyclopedia Americana*, 1976, Vol. 24, pp. 730-740

Lewis, E.V., *Ships*, Time-Life, 1970

"Ships and Seaways," Marine Environment and Population-Environment Curriculum Studies, University of Delaware, 1974

For statistics on oil and oil pollution:

Cowan, E., *Oil and Water*, Lippincott, 1968, esp. Ch. 3: "Tankers Get Larger and Larger, and That is Progress"

Hampton, J., "Superships, Superhazards," National Observer, Nov. 16, 1974, p. 28

Steinhardt, C. and J., *Energy*, Duxbury Press, 1974

Stewart, R.J., "Tankers in U.S. Waters," *Oceanus*, Fall, 1977, pp. 74-85

"Super (Tanker) (Port) Potpourri," *Ecolibrium*, Fall, 1973, p. 9

"United States Petroleum Highlights," *The Petroleum Situation*, March, 1978

On clay boats:

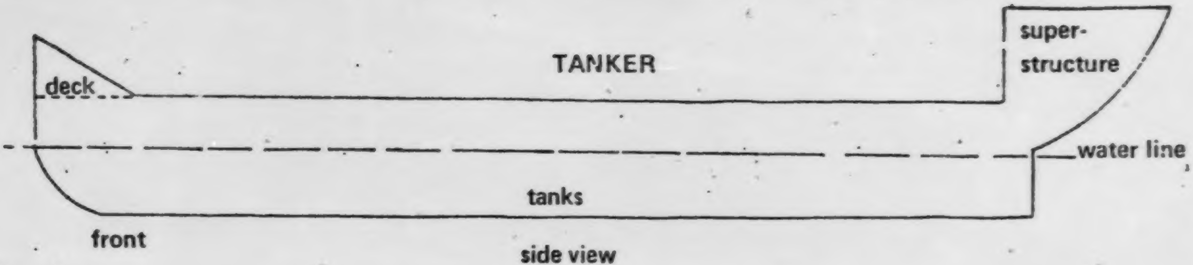
Callaghan, S.S., "Teacher's Activity Guide to Coastal Awareness," Coastal Resource Center, University of Rhode Island, Marine Bulletin No. 23, 1976,

*Teacher's Guide for Clay Boats*, McGraw-Hill, 1969

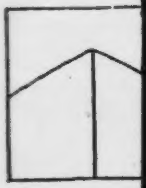
## Credit

Illustrations, Ann-Marie M. Fleming

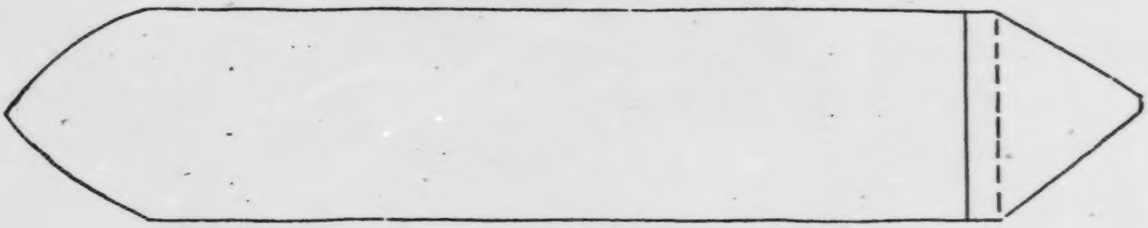
## TANKER


deck
super-structure
water line
tanks
front

side view

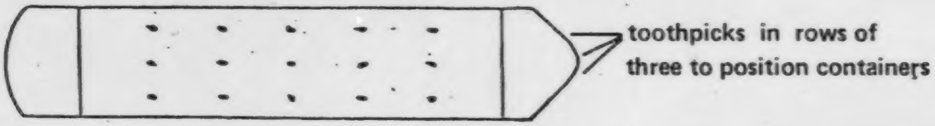


front

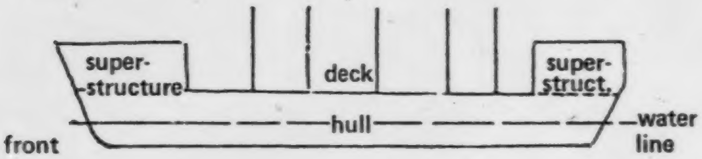


view from above

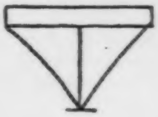
## CONTAINER SHIP


toothpicks in rows of three to position containers

view from above


super-structure
deck
super-struct.
hull
front
water line

side view



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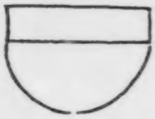
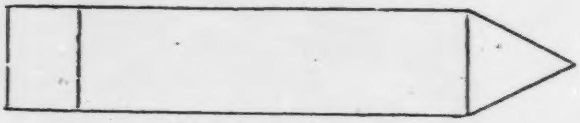
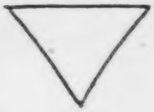
## GENERAL CARGO SHIP



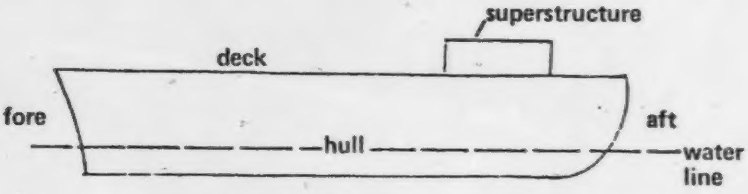
rear



view from above



front


superstructure
deck
fore
aft
hull
water line

side view

# Energy Chain

## Curriculum Topic

Foreign Relations
Economics
Urban Studies
Agriculture
Transportation

## Energy Topic

Energy Uses
Energy and Economics
Energy and the Environment

## Grade Level(s)

5-6

## Site

Classroom

## Skills

Reading, interpreting data, using information for a purpose, brainstorming

**Credit** "The Energy Challenge," Federal Energy Administration. Adapted by Ed Lisk in EARTH-WATCH, Vol. II, Environmental Education Center, Area Cooperative Educational Services, New Haven, CT, 1978.

## Objective

Students will be able to:

1. identify energy-related problems that they or their families might meet close to home.

2. relate these energy situations to the issues of population growth, production of goods and services, dependency on foreign oil supplies, concern for the environment, and changing lifestyles.

3. discuss possible solutions to energy problems.

## To The Teacher

In this activity, students will be asked to identify a link in the energy chain which a hypothetical situation represents, then in small groups brainstorm the consequences of the problem and possible solutions.

To prepare you for the classroom discussion, the following is background information on each of the five situations.

Situation 1 sets up the hypothetical problem of how to cope with sudden and severe shortages of oil in the United States as a result of a stoppage of imports. Some experts predict that the national emergency we would face would be worse than any civilian crises faced in wartime. Industry could grind to a halt; stores, schools, hospitals could close; food shortages could quickly develop. The government might have to institute rationing and allocate available fuel to selected users. Have students suggest who should have top priority.

The second situation poses a problem that may be very familiar to your students - the crowded classroom. Here is population growth close at hand. Do students, in this situation, have a choice about their population growth? Will the larger class population create a need for more goods and services? Where will people sit? Perhaps the school will go into two sessions. Can the school system afford to pay the teachers overtime? How does an increased population affect energy use?

Students may want to move from this population problem to a discussion of the growing numbers of people all over the world--and particularly the emerging nations who require increasing energy resources for their developing technologies.

Situation 3 presents two issues in the delicate balance of environmenta concern: the need for energy in urban areas and the desire to preserve the beauty and natural ecology of a wilderness recreational setting. Class members may want to debate which concern has priority. Is there a compromise?

Situation 4 points to the fact that the food production industry uses more than 12 percent of the nation's fuel budget. Increases in productivity per acre of land, in the use of farm machinery and food processing and preparation raise the rate of energy consumption. Students may be interested to learn that it takes the equivalent of a half-glass of diesel fuel to put one glass of milk on the table; two pounds of coal to produce a one-pound loaf of bread; three pounds of coal to produce one pound of hamburger. Farmers use almost as much fossil-fuel energy in the form of fertilizer as they do to operate all of their tractors.

Nearly twice as much energy is used to process foods - cutting, washing cooking, canning, freezing, drying, packaging - as it took to grow it. Transportation, storage, refrigeration, and preparation of food in the kitchen takes twice as much again. Students might suggest some of thes solutions: greater use of animal manure for fertilizer, more hand labo the planting of home gardens, fewer processed and convenience foods, people eating more vegetable/grain products (lower on the food - energy chain than meats).

Accommodating ourselves to the less convenient mode of public transportation rather than private automobiles will require a real change in American lifestyle. Situation 5 deals with this issue. The entire transportation sector uses more than 40% of our energy budget.

The passenger car accounts for 21% of this. Fifty-six per cent of all commuters drive to work alone; only 14% use public transportation. Over half the land in many cities is devoted to roads, parking lots, garages, and service stations. Transportation energy use could be cut in half if commuters used buses instead of cars.

## Before You Begin

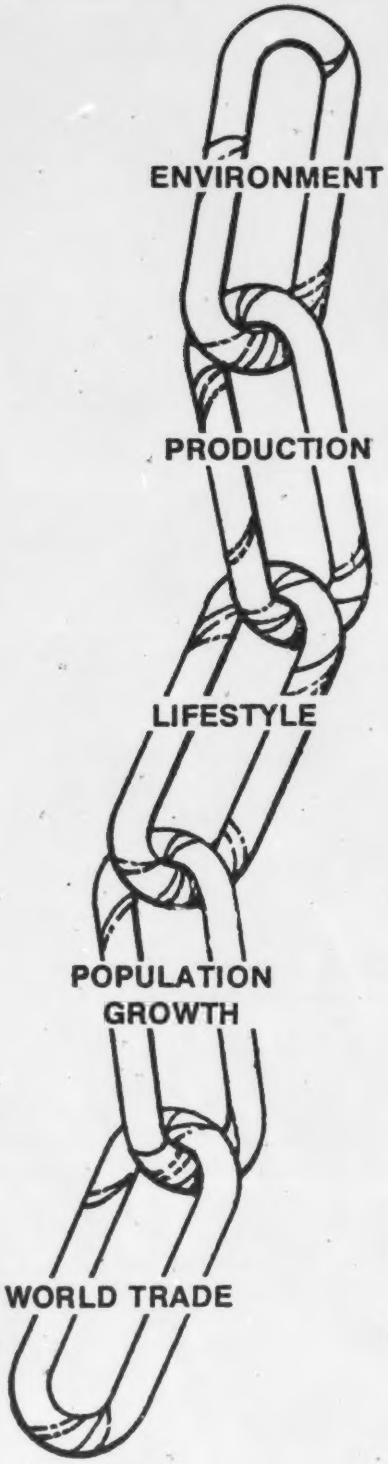
Duplicate student worksheet page.

## Words To Know

lifestyle, production, interrelationship

# STUDENT PAGE

## *The Energy Chain*



Population growth, production of goods and services, dependency on foreign oil supplies, environmental health and safety, and the effect of these on our lifestyles—each of these is a link in the chain of energy use. Each is part of the energy challenge.

Draw a line from each short story to the appropriate link. Form small discussion groups. With others in your group, define the problem in the following situations and discuss what your solutions might be.

1. Time: One possible day in the future. Canada has decided to stop exporting oil. Some of the other oil-producing countries decide to band together and withhold oil in order to raise prices. U.S. supplies of oil are suddenly cut in half. There is no milk or bread in your house, no gas in the car, and you live 5 miles from the nearest store. What kinds of problems would you and your community face if there were a serious oil-shortage? How could you solve these problems?

2. Each year the number of students in your classroom increases. This means more seats in less space, more noise, less personal help from your teacher. A new business has opened in your town, employing 300 people. Suddenly, your class size has doubled. How will this affect you and your school?

3. A large utility company is planning to build an electric generating plant right where you and your family camp and fish every summer. The coal resources are nearby (mining hasn't started yet, though) and the city 500 miles away is desperately short of electric power. Should the plant be built? Why or why not?

4. Your uncle manages a large farm that produces many food products. He operates tractors and giant combines; he runs a gasoline-powered irrigation system, cow-milking machines and crop-drying equipment. He uses fertilizers made from petroleum. Because petroleum is scarce, his costs have more than doubled. If he cuts back on his use of petroleum-based products, he would seriously reduce food production per acre. Is there any way he can cut back on his reliance on petroleum? How can consumers help cut energy needs for food production?

5. The annual operating budget of your city (your public tax money) can pay for either completion of the super highway system or enlarging the suburb-to-city mass transportation system, but not both. Most commuters don't like to ride buses, so the buses are usually only half full. The vote is coming up at the council meeting next week. How should the council vote?

# ACTIVITY

1. Distribute student worksheet.

2. Have the student read the five paragraphs and draw a line to the appropriate link in the energy chain.

3. Form small discussion groups and direct students to define the problems in each of the paragraphs and discuss some of the possible solutions.

4. As a class, consider the following questions:

(a) Are any of the links in the energy chain more important than the others? If so explain how and why.

(b) Determine the role you and your fellow students play in each of the chain links.

(c) Considering our present environmental situation, which link in the chain can most easily be controlled?

## Related Activities

1. Chart a product from production to consumption as it relates to the energy used.

2. Using the newspaper, keep a one week record of energy related stories and deduce their connections.

## Resources

Clark, Wilson, Energy For Survival, Anchor Books, Garden City, N.Y.,1975.

Energy Primer, Portola Institute, Fricke-Parks Press, Fremont, Calif,1975.

## Credit

*This activity is based on "The Energy Challange", Federal Energy Administration,

## Notes To Myself

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# New Energy Resources

## Curriculum Topic

Conversion of Energy Forms
Heat

## Energy Topic

Energy - The Concept
Energy Sources
Energy and the Environment

## Grade Level(s)

6

## Site

Classroom

## Skills

Reading, writing, evaluating information
Recognizing problems

**Credit** "The Energy Challenge," U.S. Dept. of Energy, 1976. Adapted by Ed Lisk in EARTHWATCH, Vol. II, Environmental Education Center, ACES, New Haven, CT, 1978.

## Objective

The students will be able to:

1. identify and contrast the benefits and problems of eight new energy resources.

## To The Teacher

The availability of energy resources has become a concern in the United States. The continuation of life as we know it, of progress, growth and a comfortable standard of living, depends on ever increasing quantity of energy. We now face the very real problem of limited supplies of fossil fuels, possible energy-related environmental damage, and high cost of developing alternative energy sources.

We have used our inventive genius to produce high-powered vehicles to transport our freight. We have devised heating and air-conditioning systems to keep our buildings warm in winter and cool in summer. Our food is mass-produced, processed, and packaged. We are cared for and entertained from the cradle to the grave by a steady stream of energy-consuming, labor-saving devices. And we have used our fossil fuels as if they might last us forever. We now need to increase our efforts to convert coal, our most abundant fossil fuel resource, to a more convenient and cleaner form of energy. We need to begin to act with some urgency in researching and developing other energy resources. And we need to reconsider our energy-consuming lifestyle.

An understanding of how our past energy supply and consumption has contributed to our present energy problems can help students approach the energy challenge of the future with greater respect and enthsiasm. They will see the need for other sources of energy and begin to understand the role that these alternative forms of energy might play in our future.

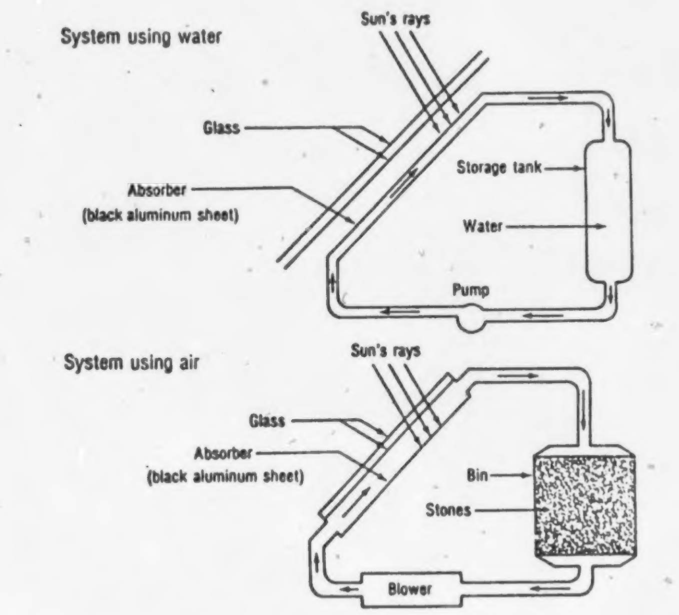
## Before You Begin

Preparation: Reproduce and distribute the Student Worksheets. Make information on energy sources available to the students.

## Words To Know

geothermal, gasification, liquefaction, pyrolysis, fossil fuel

Active Solar Space Heating Systems


System using water
Sun's rays
Glass
Absorber (black aluminum sheet)
Storage tank
Water
Pump
System using air
Sun's rays
Glass
Absorber (black aluminum sheet)
Bin
Stones
Blower

**The flow of water or stream of air carries the heat from the solar-radiation collector to the storage system (a water-filled tank or a bin filled with stones) or delivers it directly by conventional means (radiators or forced hot air) to rooms of the house.**

**Source: William A. Shurcliff, "Active-Type Solar Heating Systems for Houses: A Technology in Ferment," *Bulletin of the Atomic Scientists* 32(2):32 (1976).**

# ACTIVITY

1. Have students read the first Student Page.
2. Have students fill in the Problems/Solutions Page.
3. After completing the sheet you may want to pose the following questions:
    a. What energy sources have the fewest problems and the most benefits.
    b. Which energy sources might fill our energy needs of the future?
    c. Which sources seem more likely to work than others?
    d. List in order of importance the energy sources from most helpful to least.

## Related Activities

1. Have students search newspapers and magazines for information on the issue of nuclear power. Some students can look for pro aspects and other students the con.
2. Build a solar collector or oven.
3. Explore how different parts of the country or world are using new energy forms. This could be from recent periodicals and newspapers.

## Resources

Clark, Wilson, Energy for Survival, Anchor-Press, 1975

Energy Primer, Portola Institute, Fricke-Parks Press, California, 1974.

"Energy Facts Sheet", National Science Teachers Assoc. Oak Ridge, TN, 1977.

Turk, J., J. Wittes, R. Wittes, A. Turk, Ecosystems, Energy, Population, Saunders Company, 1975.

## Credit

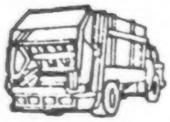
*This activity was largely excerpted from "The Energy Challenge", Worksheets from Activity #15 and #16 U.S. Dept. of Energy, 1976

# Other New Energy Resources

Besides nuclear and solar energy, there are several other possibilities for the future. Read about some of these new energy sources on this page. Problems and solutions are associated with each of them. On the next page you will decide what some of these problems and solutions are.

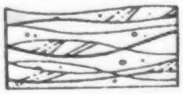
WIND. Wind is actually a form of solar energy since it is caused by variations in the temperature of the air heated by the sun that causes air to move. Sailors used this energy for ages. For many years farms have used windmills to generate electricity. Maybe giant windmills will someday be able to provide electricity for entire towns. The major difficulties are that the wind doesn't blow all the time and that practical storage systems are still being developed.

GEOTHERMAL. The earth's center is a molten mass. In some areas this mass is close to the surface. Some evidence of this are volcanos, geysers, and hot springs. This heat can be trapped and used to generate electricity to supply cities without polluting the atmosphere. The problem is that this energy can now be tapped only where it is near the surface. Scientists are searching for other areas where this geothermal energy can be reached, but they don't have all the answers yet.

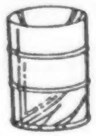


PYROLYSIS OF SOLID WASTE. It is possible to heat waste in an oxygen-free atmosphere and produce oil and gaseous products. This waste is what we're now having trouble removing from our environment: manure, garbage, paper, logging residue, some industrial waste, sewage, and the like. The difficulty is that this material tends to be scattered in small amounts at various sites. The problem is one of gathering it together at a reasonable cost.

COAL GASIFICATION. By using high temperature and pressure, coal can be converted into a gas very much like natural gas. Building these conversion plants near coal fields can solve the problem of transporting bulky fuel that gives off pollutants when it is burned. When coal gas is burned, it burns as cleanly as natural gas, causing virtually no air pollution. The usual pollution problems occur in the coal mining process, however, as they always have. The conversion process itself, however, uses large amounts of electrical energy.



COAL LIQUEFACTION. Although the technology is not completely developed, coal can be converted to an oil-like liquid. It has the advantage over coal gas of being usable to make all the usual oil products, including a kind of gasoline to run our cars.



OIL SHALE. Oil shale is a rock containing a material that yields oil when it is crushed and heated. One ton of rock will produce about 25 gallons of oil. Most oil shale deposits are in the West. The rock must be mined, either by deep mining or surface mining. Extracting the oil takes large amounts of water — three barrels to every one barrel of oil processed. One of the big problems is the disposal of the spent rock after the oil is extracted. Vegetation will not grow on the used shale without a moderate amount of rain — scarce in many parts of the West. Without vegetation, some animals may lose their homes and natural food supply. Rain water passing through this rock will possibly pick up pollutants and carry them to larger bodies of water if there is no vegetation. In addition, oil shale processing contributes to air pollution.

# Problems/Solutions

In this unit, you have learned about eight new energy resources. The use of any one of these resources may help to supply our energy requirements but may at the same time present us with new problems to consider. In the lefthand column of this page are some of these issues — some are problems, some are solutions. Mark each statement S (for solution) or P (for problem). Place a checkmark in every energy-resource column on the right to which a statement applies. The first one is done for you.

| | IF THIS ENERGY SOURCE IS USED, IT . . . | SOLAR | NUCLEAR | WIND | GEOTHERMAL | COAL GASIFICATION | COAL LIQUIFACTION | OIL SHALE | PYROLYSIS |
|---|---|---|---|---|---|---|---|---|---|
| ______ | WOULD HELP SOLVE THE PROBLEM OF SOLID WASTE DISPOSAL. | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ |
| ______ | COULD POLLUTE WATER. | | | | | | | | |
| ______ | WOULD CONSERVE THE DWINDLING RESERVES OF FOSSIL FUELS. | | | | | | | | |
| ______ | COULD DAMAGE WILDLIFE OR THEIR HABITAT. | | | | | | | | |
| ______ | WOULD BE DIFFICULT TO STORE AND TRANSPORT. | | | | | | | | |
| ______ | WOULD NOT POLLUTE THE ATMOSPHERE. | | | | | | | | |
| ______ | WOULD DISRUPT THE NATURAL USE OF LAND SURFACES. | | | | | | | | |
| ______ | WOULD NOT BE ABLE TO SUPPLY ENERGY ALL THE TIME. | | | | | | | | |
| ______ | WOULD HAVE TO WAIT UNTIL THE TECHNOLOGY IS DEVELOPED. | | | | | | | | |
| ______ | WOULD USE LOTS OF WATER TO PROCESS. | | | | | | | | |
| ______ | WILL DECREASE THE NEED FOR OIL IMPORTS. | | | | | | | | |
| ______ | WILL MAKE LARGE AMOUNTS OF WASTE MATERIAL. | | | | | | | | |
| ______ | WILL MAKE USE OF THIS COUNTRY'S MOST ABUNDANT FOSSIL FUEL. | | | | | | | | |

# TAXONOMY OF SKILLS

I. BASIC SKILLS -

Reading
Writing
Computing
Listening
Speaking
Analyzing

II. ACQUISITION AND/OR VERIFICATION OF INFORMATION

A. Information Skills

1. Locating and obtaining information (reading, listening, or observing).
2. Organizing information
3. Using information for a purpose
4. Communicating information (orally or in written form)
5. Evaluating information

B. Data Skills

1. Collecting and compiling data
2. Interpreting data
3. Infering from data
4. Graphing data
5. Mapping data
6. Measuring
7. Constructing hypothesis
8. Testing hypothesis
9. Predicting

III. PROBLEM-SOLVING SKILLS

Listening with comprehension

Recognizing problems

Defining problems

Locating and obtaining information

Organizing information

Analyzing information

Generating alternate solutions

Developing a plan of action

IV. VALUING SKILLS

Identifying alternatives

Identifying consequences of alternatives

Identifying feelings about alternatives

Choosing freely

V. OTHER SKILLS

Classifying

Observing

Experimenting

Concluding

Constructing models

Reading maps

Interpreting maps

Brainstorming

Implementing

Intuiting

VI. PERSONAL SKILLS

Developing self confidence

VII. GROUP SKILLS

VIII. CITIZENSHIP SKILLS